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(*To be continued.*)

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TRALIZING FORCES AND EQUIPMENT OF THE TELEPHONE EXCHANGE.

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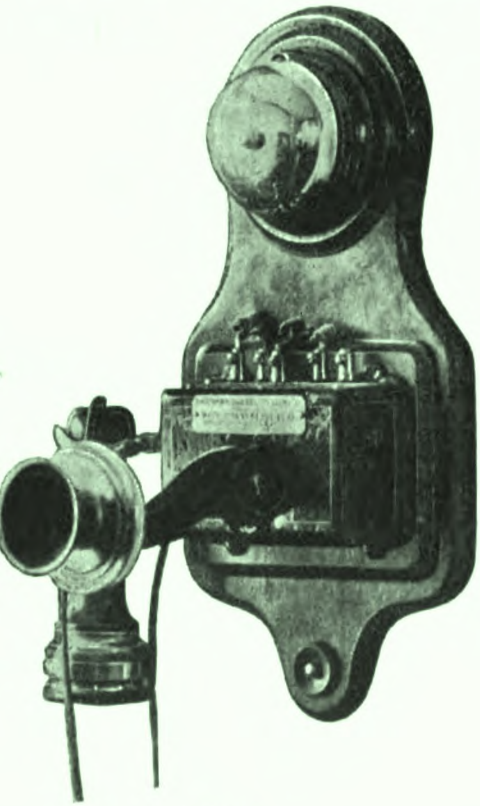

FIG. 1.

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Electrical Engineering
And Telephone Magazine

AN ILLUSTRATED MONTHLY MAGAZINE.

VOLUME XII,

August to December, 1898.

EDITED BY

CARL E. KAMMEYER.

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CONTENTS OF VOLUME XII.

(Copy.)

LA PORTE TELEPHONE CO.

La Porte, Ind., August 5, 1898.

To whom it may concern:

It having been published that this Company took out an Automatic System and put in a Manual Service System because the former was unsatisfactory--

This is to certify, this Company owned the first Automatic Telephone Exchange built in this country, when the system was in a very crude state as compared to its present style.

When we put it up seven years ago we employed the old flat Zither board and made the calls by push buttons on the telephones. Even with this primitive arrangement the service was entirely satisfactory, more so than it is possible to be made by any Manual system.

Our reason for taking out the system was that at the rates we received there was not sufficient profit to justify the putting up of new lines, and as our people were willing to submit to an indifferent and party line service, and as we could get a number of more subscribers, but had no capital with which to put in metallic circuits, it was decided to return to common return circuits, thus putting two 'phones where one had been employed, and putting two or more on one wire.

By this we could increase our subscribers without additional outlay, and as our people were willing to accept such service we found it to our interest to make the change.

The Automatic in its present state cannot be equaled, where a constant, efficient and secret service is desired. Especially will this be true where large exchanges are concerned.

Respectfully,

(Signed) LA PORTE TELEPHONE COMPANY.

By S. I. Kessler, President.

Electrical Engineering
And Telephone Magazine

VOL. XII. CHICAGO, AUGUST, 1898. NO. 83.

PARTY LINES.

BY KEMPSTER B. MILLER, M.E.

Probably no branch of telephone work has offered more advantages to the inventor and designer and consequently received a greater share of ingenious application than the party-line problem.

A party line, or *many party line*, as it should undoubtedly have been called, is a line having more than two stations upon it. This definition probably needs a little explanation, as a line running from a central office to two stations only is a party line in every sense of the word, and we must therefore and very properly count the central office as a station, thus making three in all. The term party line is used in distinction from *private line*, which may be defined as a line connecting a central office with one subscriber only, or one subscriber with one other only.

Party lines may be divided into two general classes:

(1) Those where a code of audible signals is employed to enable the various parties to distinguish their calls from those of others.

(2) Those where a system of selective signaling is employed so that any one party may be called up without disturbing any of the others.

The first of these classes may be divided into two general sub-classes, according to the connection of the instruments on the line, as follows:

(a) Those on which the instruments are connected in series in the line circuit.

(b) Those on which instruments are connected in multiple in the line circuit.

The second or selective signaling class of lines may be divided into three subclasses, according to the method of selective signaling used, as follows:

(*a*) Those employing step by step movements to complete the desired circuit.

(*b*) Those using the harmonic system of selecting,—that is, those using currents of various frequencies for actuating the different signals.

(*c*) Those using currents of different strengths or different polarities or both, for operating the different signals.

The nonselective systems will be discussed first, and for dealing with this very familiar subject at as great a length as I shall, I offer two reasons, the first of which is that the party line is the first plan usually adopted in communities where but a few subscribers exist, and in such communities it is but seldom that a man is found with the requisite knowledge for distinguishing between a series or a multiple connection of telephones. I have good reason to know that a large majority of the installers of party lines have, to say the least, the vaguest notions as to the principles involved and as a result frequently connect up series instruments in multiple, or what is worse, multiple instruments in series, or what is still worse, if possible, to indiscriminately mix the two kinds of instruments on one circuit. My second reason is that any set of articles would be far from complete without a fairly comprehensive treatment of the nonselective class of party lines, inasmuch as in this

class are probably ninety-five per cent of all the party lines of this country.

Probably the first party line ever constructed connected the instruments in the line circuit in series; there are records, however, in the very early days of telephony, of their connection in multiple.

In the series party line the usual form of wiring is used and is substantially that shown in Fig. 1. In this the switch lever L cuts out the talking apparatus, consisting of the transmitter T, induction coil I, receiver R and battery B, and completes the circuit through the calling generator G, and polarized bell P, while the lever is down, and accomplishes the reverse connections when the lever is relieved from the weight of the receiver. Instruments of this kind are connected *directly in* the line circuit, that is, the line wire is cut and the two terminals so formed are connected to the two binding posts 1 and 2. In other words, the line circuit enters one binding post of the instrument, passes through the circuits of the instrument and out at the other binding post and to the next instrument, and so on through the entire circuit.

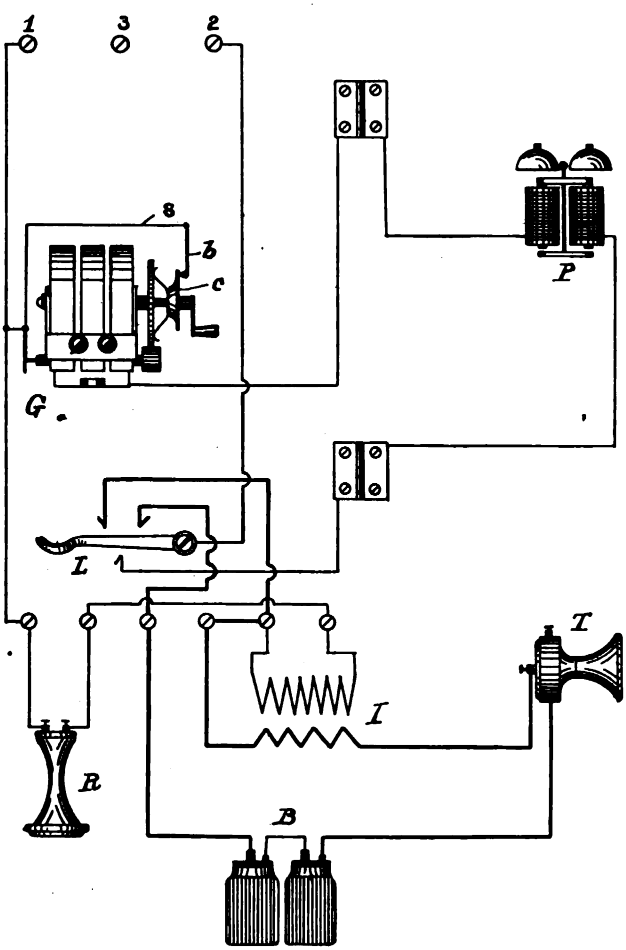

FIG. 1. CIRCUITS OF SERIES TELEPHONE.

A grounded line of four such instruments is shown in Fig. 2. This figure simply illustrates the method of connecting the telephones in the line wire, it being understood that all of the instruments are wired substantially in accordance with Fig. 1.

A little consideration will now show one of the chief disadvantages of the series line. The talking circuit of any two stations engaged in conversation must always pass through the bell magnets of all the other stations. As these magnets necessarily possess considerable impedance, this is a very serious objection, and when a great number of instruments are used the talking becomes very faint. For this reason it is customary to wind the bell magnets on instruments to be used on series lines to a low resistance, rather lower in fact than on the ordinary exchange instruments. Eighty ohms for each complete double magnet is a very good resistance, the winding being of No. 31 single silk-insulated copper wire.

It might be thought at first sight that the resistance of the armatures of the magneto generators would also be included in the circuit. This was true in the earliest forms of instruments, and proved a most serious objection. Now

every good series instrument is provided with what is termed an automatic shunt, which provides that a path of practically no resistance shall always be closed about the generator armature, except at such times as the generator is being operated. Such a shunt is well shown in Fig. 1, where *s* is the shunt wire, normally connecting the armature spindle spring with the frame of the generator through the medium of the spring *b* and the contact disk *c*. This forms a short circuit

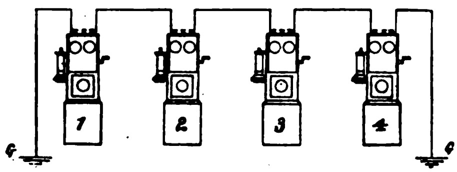

FIG. 2. SERIES GROUNDED LINE.

around the armature winding, as is readily seen. When, however, the generator crank is turned, the disk *c* is pressed out of engagement with the spring *b* by the wedging action of a pin on the shaft against the side of a spiral slot on the crank sleeve. Many other forms of automatic shunts have been devised, the one shown being typical.

The number of bells which can be rung on a series line is far in excess of the number that can be talked through. Thus fifty instruments would have a combined resistance of 4,000 ohms, and if we assume a very high line resistance of 3,000 ohms, we have a total resistance of only 7,000 ohms, which any good generator could easily ring through. Fifty instruments in series, however, or even half that number, without line resistance, give almost intolerable talking service.

Such a line as that shown in Fig. 2 would, moreover, be susceptible to all the inductive trouble to which the telephone is heir. This can, of course, be partly remedied by making the circuit a complete metallic one, and transposing the line at frequent intervals; but even this will not do away with the trouble altogether, as it is impossible to get a proper balance between the two sides of the circuit.

The generators for series instruments should be wound for producing a high electro-motive force, inasmuch as there is always a great amount of resistance to be overcome. A good type of generator is one wound with No. 35 single silk-covered wire to a resistance of 550 ohms. Such a generator, with proper mechanical construction and good permanent magnets, will easily ring through 15,000 ohms.

It is well to explain here what is meant by the terms "ten thousand ohm" or "twenty-five thousand ohm" generators. It means that the generator will ring its own bell through the resistance specified. The necessity for giving this definition may not be clear to some, but I have frequently been asked whether the "ten thousand ohms" refers to the *actual resistance* of the generator armature or the ringer magnets, or the *receiver* or *induction coil*.

The bridging or multiple system of party line working is now rapidly superseding the series system. Fig. 3 shows the method of attaching the telephones to a single or grounded line according to this plan.

The line wire *l* is continuous through all the stations, and each instrument is placed in a separate bridge wire *b* or tap to ground. If the circuit is to be metallic, the ends of the bridge wires *b*, which are shown connected with the ground, are connected instead with the second line wire.

The circuits of a bridging instrument

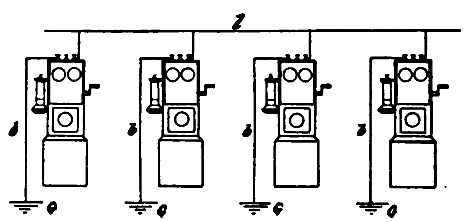
FIG. 3. BRIDGED GROUNDED LINE.

are shown in Fig. 4, and the line connections of an eleven station metallic circuit line in Fig. 5. This latter figure is a reproduction of a figure in the famous Carty patent alleged to control the art of bridging telephones.

In this system the call bells P at each station are *permanently* bridged across the two sides of the line, and are made of high *resistance* and *retardation*. The generator G at each station is in a

separate bridge circuit, which is normally open, but closed when the generator is operated. The talking circuit of each instrument, containing the receiver R and secondary winding of the induction coil I, forms a third bridge circuit, which, like the generator circuit, is normally open.

The telephone circuit of each instrument is automatically closed when the receiver is removed from its hook for use, and this operation also closes the local circuit containing the primary of the induction coil I, the local battery B, and the transmitter T. In order that there shall not be an undue leakage of the voice currents through the permanently bridged call-bell circuits, the magnets of these call bells are wound to a high resistance (usually a thousand ohms) and are also constructed in such manner that they will have a high coefficient of self-induction. When a generator at any one station is operated, it is connected across the two sides of the line in parallel with all of the call-bell magnets on the line. Part of the currents in this generator will, therefore, pass through each of the call-bell magnets on the line, thus causing them all to operate if the amount of the current generated is sufficient to accomplish this result. The successful operation of this system depends on the fact that a coil possessing a high coefficient of self-induction will transmit with comparative ease alternating or pulsating currents of low frequency, while it will form a practical barrier to similar currents having a very high frequency. The currents generated by the calling generator at any station are of sufficiently low frequency to pass with comparative ease through the call-bell magnets arranged along the line, while the rapidly alternating voice currents impressed upon the line by the telephonic apparatus at any station will be compelled to pass over the main line to the receiving station without being materially weakened by leakage through the call-bell magnets. At the receiving station these voice currents will pass through the telephone receiver and secondary coil of the induction coil, these being connected across the line at that station by virtue of the receiver being off its hook. This path through the receiving instrument is of comparatively low resistance and retardation, and thus practically takes all of the current from the distant station.

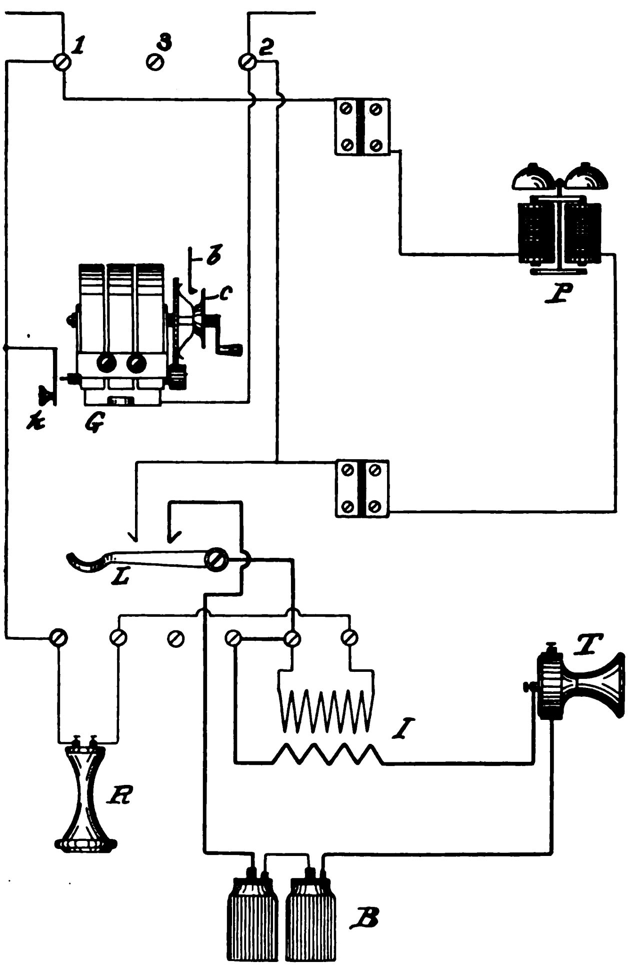

FIG. 4. CIRCUITS OF BRIDGING TELEPHONE.

The closing of the generator bridge upon the sending of a call may be accomplished manually, as with the key *k* in Figs. 4 and 5, or automatically, in much the same manner as that described for breaking the shunt around the generator in the series instrument. Thus, if the wire leading from binding post 2 in Fig. 4 were led to the spring *b* instead of to the frame of the generator, it is evident that the inward movement of the disk *c*, caused by turning the generator crank, would accomplish the same result as pressure on the key *k*, and with the advantage of not requiring the volition of the operator.

The high retardation of the ringer magnets is obtained by winding them to a high resistance with a comparatively coarse wire so as to obtain a large number of turns in the winding. The length of the cores is increased for the double purpose of getting more iron in the magnetic circuit, and therefore a higher retardation, and also for affording a greater amount of room for the winding. The Western Electric Company, I believe, wind their coils to a resistance of 1,000 ohms, using No. 33 single silk magnet wire. Many other companies use No. 38 wire and wind to a resistance of 1,200 or 1,600 ohms. This does not give such good results, however, as using the coarser wire and the lower resistance and long cores. Some companies wind, or once wound, their bridging bell magnets partly with German silver wire in order to make a high resistance at a low cost. They should learn, however, that resistance in itself is not the thing desired, but a great number of turns in the winding, which, of course, incidentally produces a high resistance.

The generators for bridging systems should be designed for quantity of current rather than high pressure, since they have to supply current to pieces of apparatus arranged in multiple. The fact that in some instances a high voltage also is needed must not be overlooked. On long iron lines, heavily loaded, sufficient *current* must be generated to ring all the bells in multiple and sufficient *voltage* to ring the bells at the farthest end of the line. In this case it becomes a question of watts, horse-power, or, more properly, man-power. The winding of the generator is, therefore, a question of vital importance and must vary to meet different requirements. A

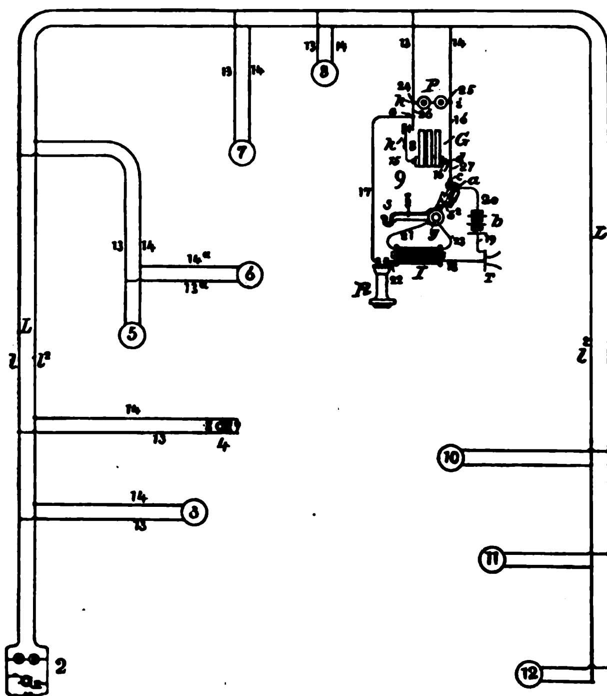

FIG. 5.

generator wound to 350 ohms with No. 33 wire makes a first-class one, however, for ordinary bridged lines where copper circuits are employed.

It is undoubtedly better on bridged circuits to use low wound induction coils, so that the voice currents coming along the line wire will find a much readier path through the talking circuit of the station receiving than through the call-bell bridges at the various stations. In many cases the use of 500, and even 1,000 ohm induction coils on bridged circuits renders the impedance of the

talking circuits higher than that of the call-bell circuits, which is exactly what should be avoided.

The smart contractor who specifies 25,000 ohm generators and 750 ohm induction coils for instruments to be used on a bridged line would probably meet greater success in the field of politics than in that of telephony.

(To be continued.)

CENTRALIZING FORCES AND EQUIPMENT OF THE TELEPHONE EXCHANGE.

Much thought and study has been given by telephone engineers in recent years to the concentrating of as much of

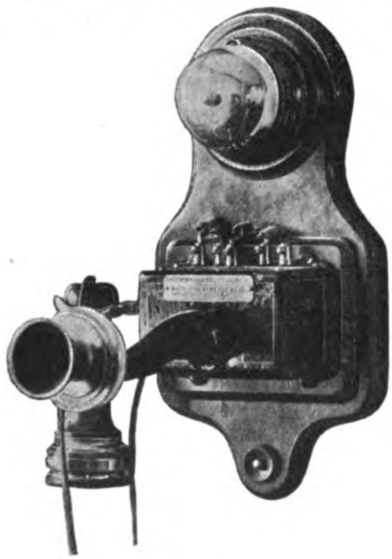

FIG. 1.

the equipment and source of energy of exchanges as is possible at the central office, not only on account of its greater convenience and desirability to subscribers, but also from an economical point of view.

A marvelous advance in this direction is shown in the "Central Energy System" recently put on the market by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. Fig. 1 shows a station instrument as used in exchanges where battery call can be employed. In this system the talking battery of the entire exchange, as well as batteries for calling the subscribers and for signaling central, are placed at the central office. The battery requirement

FIG. 2.

is about one-tenth of that necessary in the ordinary system.

In exchanges where generator power is required for calling subscribers, an instrument such as shown in Fig. 2 is used. This instrument is furnished with a ringer and bells, neatly mounted underneath the battery-box shelf, and it is provided with a battery box so that local

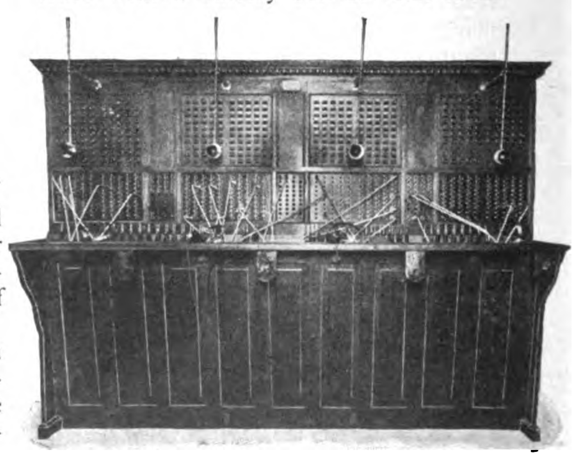

FIG. 3.

talking battery may be used if preferred.

The instrument, however, has no generator, which in the ordinary system

requires brisk turning by the user, and is a great inconvenience and annoyance to subscribers as well as a constant expense to the exchange. A push-button is provided instead, which by pressing closes the circuit and throws in a current generated at the central office. This throws a drop at the switchboard, and rings its own bell. The subscribers are called in the ordinary way with a hand or power generator.

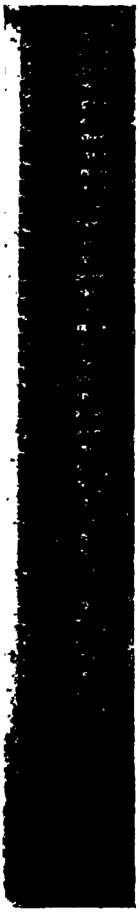

FIG. 4.

The switchboard, Fig. 3, is, in general construction, the same as in the individual magneto call system, the only difference being in the wiring. It is claimed to be free from cross-talk and induction, and absolutely clear of all patent claims of others. It evades the claims in the patent still in question, covering any switching device in the cord-circuit by throwing in the operator's instrument directly at the spring jack through the tip of the plug. It is considered to be one of the most convenient and durable boards on the market.

Fig. 4 represents a combination fuse and carbon lightning arrester furnished by the company.

The Central Energy System was thoroughly tested for more than a year in large private plants before being placed on the market for public use and is now in actual operation in a number of public exchanges. It is considered to be perfectly reliable for general use.

AN infringement suit has been brought by Necter, Rousseau & Brennan against the Central Union Telephone Company for alleged infringement of the plaintiffs' patent on a form of transposition insulators, which it is said is being unlawfully used by the telephone company. Charles C. Bulkley is attorney for the plaintiffs.

A NEAT TELEPHONE INSTALLATION.

One of the first exchanges installed by the Victor Telephone Manufacturing Company has just been completed at Austin, Illinois, for the Cicero Telephone Company. A 300-line, latest type, common return board is the principal feature of the equipment and elicits much favorable comment on account of its fine workmanship and perfect operation. A novel and interesting feature of the board consists of a simple device for testing the working condition of the cords, thereby anticipating any danger of subscribers being cut out by defective cords. Little devices of this kind are what add to the Victor's popularity.

PROGRESS OF THE STROWGER SYSTEM.

The Automatic Telephone Service Company, of Buffalo, New York, which is using the Strowger system in all its exchanges exclusively, has just been granted a franchise to build and operate a telephone exchange in the city of Rochester, New York. The Strowger Automatic Telephone system is now in successful operation in some twenty exchanges, but as Augusta, Georgia, is the largest city so far which is using the Automatic, the Strowger Company is to be congratulated on having an opportunity to get its system into as large a city as Rochester.

The automatic system is certainly destined to become *the* telephonic system of the future. Its quick service and secrecy alone entitle it to rank foremost in telephony. At the outbreak of the American-Spanish war, the secret service of the automatic telephone system was brought to the attention of President McKinley, and after due investigation the White House was at once equipped with the Strowger automatic instruments to connect with the different governmental departments, and, after several months of successful service, the offices of the Coast and Geodetic Survey were also supplied with an automatic switchboard. The Strowger Company is constantly forging ahead in its business, improving the mechanism of the automatic telephone system and building exchanges.

MUNICIPAL OWNERSHIP.

BY JOHN WALTON BOURKE.

When I promised to prepare a paper for the January meeting of your association, I was not aware of the experience soon to be acquired, else I would have known how impossible it would be for me to devote a moment of time to aught but saving my investment from threatened destruction by friendly faddists; for these kind friends nearly succeeded in establishing a municipal lighting plant in our city, and now regard me as a bitter enemy to all good works because, in defending my personal interests, I defeated their plans. The trouble came about in this way:

Some time ago a reputable firm of contracting engineers submitted a reasonable proposition to our mayor, to supply arc lights of 2,000 candle-power to burn all night and every night, for the low rate of $65. As the wording of the proposition indicated a fair knowledge of local conditions, I concluded that this firm was watching the trend of public sentiment in certain towns and cities where the street-lighting contract is about to expire, in order to intelligently submit an attractive proposition.

The proposition submitted to our mayor included the complete construction of a lighting plant having an operating capacity of 600 arc lamps of 2,000 candle-power, and 1,000 incandescent lamps, all for $125,000, the station to be erected on land owned by the city. It was further proposed to operate this plant for a term of five years or ten years at a net expense to the city of $65 for each arc lamp, on the basis of 600 arc lamps.

We were receiving $100 yearly for each arc light in service, and were keeping the lamps well trimmed and up to full candle-power; no complaints of poor service had been received, nor any expression of a desire for a change. Hence, I was simply astounded when informed that the proposition would be favorably indorsed by the city council. Making a hurried investigation, I found that some inexperienced but enthusiastic "municipal reform" faddists were responsible for the movement; so I joined hands and advocated not only municipal but State and Federal ownership.

With Goethe, I can say that I respect a man who knows distinctly what he wishes. The greater part of all the mischief in the world arises from the fact that men do not sufficiently understand their own aims. Thus, bitter experience has taught me that the quickest way to silence an enthusiast advocating a movement the elementary principles of which are unknown quantities in his knowledge box, is to ruffle the sensitive source of his income. As the leader in this movement was the principal stockholder in three large coal mines in our State, I devoted a few days to quietly hunting for facts. A week later I mailed to every prominent citizen a copy of an interesting four-page pamphlet clearly but concisely portraying, in temperate but truthful language, the wretched sanitary condition of the homes occupied by the miners employed by our friend, the unjust treatment they were often compelled to submit to, and the many advantages that would follow and the great saving that would accrue to all users of soft coal if these mines were operated by the State. That the poor who now pay 10 cents a bushel for an inferior quality

of coal would then receive the best for about 3 cents a bushel; and that as ninety-one per cent of the population were coal users, while less than four per cent were buyers of electric light, it was certainly to the advantage of the people to have the mines owned and operated by the State. Quite naturally, this first pamphlet raised a h—— of a row; but it diverted attention from the lighting scheme for the moment.

The next important member of the reform committee was a prominent baker. A few days later I sent out a pamphlet calling attention to the desirability of the city baking all the bread its citizens required, not only on the score of economy, but for reasons of cleanliness and health. Some reproductions of photographic interior views of portions of my friend's bakery illustrated the very points I desired to bring out. To be sure, they were taken at the closing hour, when the men were tired and less likely to be as scrupulously clean as in the earlier hours. But I quieted my conscience with the thought that neither friend had shown the slightest hesitancy in attempting to wreck my enterprise, or to place me in a false position before the community.

Then I paid my respects to the third member of the committee, who owned an extensive milk route and supplied all the more prominent people. Laying aside the question whether his cans and pails were always clean, it did not require many hours of quiet investigation to obtain facts to convince the most skeptical that the methods of some milk dealers were of a most repulsive, unclean and disheartening character. And here the camera again played an important part in illustrating under what filthy conditions the cows were housed and fed, and how milk absorbed the foul and disease-breeding odors. On the appearance of this leaflet the press came to my aid and made such a determined fight for cleanliness in behalf of the milk user, that my committee friend had his time fully occupied in almost hourly inspecting every detail of his business to prevent the press from exaggerating some trivial fault; for they fairly flayed the unscrupulous milk dealers. Incidentally, I also unfolded a plan whereby the city could own large dairy farms and profitably supply the richest of milk for 3 cents a quart. While the papers combated this plan, it was admitted that under competent supervision the citizens could be supplied with a more desirable quality of milk, free from the petty annoyances incident to the visit of a dozen milk peddlers to the residents in a block in the early hours in the morning, and that there were several other fields, far more essential to the comfort of the average citizen than the electric light field, which the city might well occupy, if the city was bound to enter into competition with private capital.

Having given these restless reformers something to occupy their attention of so personal a nature that they would have no time to devote to my affairs, I proceeded to formulate a scheme for educating the principal taxpayers to a proper understanding of the fallaciousness of the arguments advanced in favor of a municipal lighting plant.

I took the public into my confidence and published a sworn statement showing what the original investment was, the gross income for each year, cost of maintenance and operation, and that our net profits for the whole period was only nine per cent on our actual investment. Our first investment was for 20-light arc machines belted to small engines; these we displaced with 50-light arc dynamos and Corliss engines; then we purchased 100-light direct-connected machines, which we have just installed. These

changes were all in the line of economy and of efficient management, and the results justified the increased heavy investment that was made. Of course there was a heavy depreciation charge, for the old apparatus was sold for a fraction of the purchase price. Again, I showed that after eight years' service every dollar invested in the arc lamps was wiped out, making, with the interest included, a depreciation charge of seventeen per cent per year. Then, in the beginning, we used small poles ; later we substituted 40-foot and 50-foot poles, necessitating a further heavy investment. Now our city council is discussing the advisability of having all the wires placed underground ; if this is carried through it means a further investment of more than $60,000 in our business.

TIRED OF THE BELL IN CANADA.

Our cousins over in Canada are evidently longing for the time when they will enjoy the benefits of telephone service at a reasonable price, judging from the following editorial in the Ottawa *Citizen*, of July 22.

The Bell Telephone Company, one of the most grasping monopolies in the country, seems to have killed the goose that laid the golden egg. A rival company has been formed in the West and it is extending its lines eastward to compete with the Bell Company. London has already granted the new company a fifteen-year franchise, and St. Thomas, Brantford, Hamilton, and other cities are prepared to welcome it. The days of exorbitant telephone rates are numbered.

MR. MARTIN J. INSULL announces that he has withdrawn from the firm of Sargent & Lundy and will hereafter act as manufacturers' agent, with offices at 1013 Monadnock block, Chicago. Mr. Insull has been engaged in the electrical business for years and his wide acquaintance among the trade will undoubtedly enable him to secure a generous share of the business.

WHERE THE TELEPHONE HURT BUSINESS.

A man who had stopped at a South Side grocery to pay a small account was present when the telephone bell rang and overheard this much of the conversation, says Carl Smith in the Chicago *Record* :

"Yes, this is Hinckley's, yes."

"Mr. Brown, of 4543 Dewey boulevard — all right."

"You won't be home — sudden business — all right."

When the grocer turned to his waiting customer, he said: "There, that's the ruination of my trade."

"What is?"

"Why, that telephone."

Then he proceeded to explain.

"There's a fine residence neighborhood around here," he said, "and when I started in a year ago I practically had all the trade. I was progressive and wanted to branch out, and so, among other improvements, I put in a telephone. The Dutchman up the street was too slow to imitate my example and I relied upon getting all his trade in addition to that which the former proprietor turned over to me here.

"Well, what happened? The first day my name went into the directory I received a telephone call from Mr. Niles asking me to send around and tell Mrs. Niles he wouldn't be home for dinner — maybe not at all that night. Mrs. Niles heard and froze me and treated me like an enemy who had lured her husband out of his house. She quit dealing with me. Shortly after Mr. Bartholomew called me up and requested me just to step around and tell his wife he had a big trade on and couldn't come home. I did so, and in her disappointment Mrs. Bartholomew acted toward me like a Spaniard. She has never been in the store since. A few days later Mrs. Davis looked at me stonily because I took the trouble to walk over and present the excuses of Mr. Davis, who would not be home. That withdrew $80 a month from me. The Poppletons and the Fosters and the Karbachs also dropped out on account of the vexation of wives whose husbands used me as a breaker of the faith.

"Maybe you've sometime found an acquaintance in a state of inebriety and for very pity and kindness of heart have taken him home. Do you remember what his wife said to you? She rebuked you for leading her husband astray and heaped bitterness upon you. That's the way with my customers and the telephone. I am simply an accomplice of the men who want to stay down-town.

"I'll either have to take the 'phone out or break up."

Evidently he chose the braver course, for when the customer passed that way a month afterward there was a "sheriff's sale" card at the door.

ELEMENTS OF COMPLEX QUANTITIES AND VECTORS
WITH REFERENCE TO THEIR USE IN ALTERNATING-CURRENT WORK.*

BY FRANZ J. DOMMERQUE, M. E.

ALTERNATING CURRENTS.
B. *Oscillatory Motion.*

There are cases where the oscillations do not keep up continuously with the same amplitude, where a resistance opposes the motion of the oscillating point, and where no prime mover is there to help the point over it. Such oscillations we find, for instance, in electrical measuring instruments (galvanometers) where the needle, being surrounded by metal, generates in its motion currents, the intensity of which is proportional to the velocity of the needle, and which dampens the motion of the needle with a force proportional to their intensity, or also proportional to the velocity of the needle; or in the discharge of a Leyden jar or a condenser where a surging of the electrical charge is sometimes set up, with the result that the current which passes through the circuit is of the nature of a gradually dying-away oscillation. Though strictly speaking the oscillations continue indefinitely, practically they are of very short duration, as in a very short time they become imperceptible. A mechanical illustration of such a case is a pendulum immersed in some viscous fluid when suddenly released from an inclined position; it will swing backward and forward with a gradually decreasing amplitude of oscillation until it comes to rest. Taking this resistance into account, the acceleration $\frac{dv}{dt}$ will no longer be as great as was shown in equation (147), but decreases according to the fact that the resistance offered to the motion at any moment is proportional to the velocity at that moment.

Let 2ρ be the resistance, corresponding to the velocity $= 1$

(we use 2ρ on account of easy manipulation afterward); then we have the new equation, which differs from equation (147) by the resistance offered by the retarding force of damping in the galvanometer example or the resistance of the viscous fluid in the pendulum example, which must be subtracted, thus:

$$\frac{dv}{dt} = -\frac{p}{M}y - \frac{2\rho}{M}v; \tag{154}$$

as $v = \frac{dy}{dt}$, we can write this equation

$$\frac{d^2y}{dt^2} + \frac{2\rho}{M} \times \frac{dy}{dt} + \frac{p}{M}y = 0.$$

To have easier sailing, put

$$\frac{p}{M} = k^2 \text{ and } \frac{2\rho}{M} = 2q;$$

then

$$\frac{d^2y}{dt^2} + 2q\frac{dy}{dt} + k^2y = 0. \tag{155}$$

In this equation we have, besides the variable itself, also differentials of the variable. Such an equation is termed a *differential equation*, and as the function equals zero, it is a *homogeneous differential equation*. By solving the above equation we gain two points: First, we learn another application of complex quantities; and second, we become familiar with a branch of mathematics which is of the greatest value in physics, really without which physics would never have been brought to what it is today. We may have given a finite equation between y and t (in physical problems almost everything is a function of the time), where besides y and t some constants enter. This equation we call the *primitive* equation. By differentiating such a primitive equation we obtain a differential equation, which is a differential equation of the first order, as only a first differential appears therein. We can repeat the differentiation and obtain a differential equation of the second order, and so on. In this manner we may obtain as many equations as there are repetitions of the differentiation, the n^{th} equation possessing no higher differential than of the n^{th} order. This last equation will be a differential equation of the n^{th} order, containing n constants less than the primitive equation between y and t, and we can say that *the primitive equation expresses that relation between y and t which satisfies the differential equation of the n^{th} order*, or shortly, *the primitive equation is*

the integral of the differential equation. When, on the other hand, the differential equation is given and the finite equation is to be found, we say the finite equation is the integral of the differential equation. The finite equation can contain n constants not contained in the differential equation of the n^{th} order. If actually these n constants are in the finite equation between y and t, we say the finite equation is a *complete* integral of the differential equation; if, however, the finite equation which satisfies the differential equation of the n^{th} order contains less than n constants, we call it a *particular* integral of the differential equation. At present we do not possess a general method by which we can integrate homogeneous differential equations. All we can do is to find solutions for some particular cases, like the one we are dealing with now.

Experience has shown that we can obtain in our case, which is a differential equation of the second order, a complete integral by putting $y = \varepsilon^{\lambda t}$ (ε being the base of the system of Napierian logarithms, and λ a constant to be determined hereafter). Here y is a function of λt and λt is a function of t; applying first the rule given in a note to equation (62) and then equation (87), we get

$$\frac{dy}{dt} = \frac{d\,\varepsilon^{\lambda t}}{d\,\lambda t} \times \frac{d\,\lambda t}{dt} = \log_\varepsilon \varepsilon \times \varepsilon^{\lambda t} \times \lambda$$

and as $\log_\varepsilon \varepsilon = 1$, we have

$$\frac{dy}{dt} = \varepsilon^{\lambda t} \times \lambda$$

and

$$\frac{d^2 y}{dt^2} = \frac{d\left(\frac{dy}{dt}\right)}{dt} = \frac{d\,(\lambda\,\varepsilon^{\lambda t})}{dt} = \lambda^2\,\varepsilon^{\lambda t} \qquad (156)$$

Substitute these values in equation (154); then

$$\lambda^2\,\varepsilon^{\lambda t} + 2\,q\,\lambda\,\varepsilon^{\lambda t} + k^2\,\varepsilon^{\lambda t} = 0$$

$$\text{or,} \quad \varepsilon^{\lambda t}\,(\lambda^2 + 2\,q + k^2) = 0. \qquad (157)$$

This equation can only be true when the expression in the brackets equals zero. Hence it must be

$$\lambda^2 + 2\,q + k^2 = 0$$

$$\text{and} \quad \lambda = -\,q \pm \sqrt{q^2 - k^2}.$$

We thus find two particular integrals of our differential equation, one corresponding to $\lambda = -\,q + \sqrt{q^2 - k^2}$ and the other one corresponding to $\lambda = -\,q - \sqrt{q^2 - k^2}$; however, we can form

a new integral by combining the two integrals by addition, and obtain thus

$$y = C_1 \varepsilon^{(-q+\sqrt{q^2-k^2})t} + C_2 \varepsilon^{(-q-\sqrt{q^2-k^2})t} \qquad (158)$$

There are two constants, differing from each other, added in the above equation, which is essential in order to preserve the independence of the two particular integrals, for if we should, for instance, put $t = 0$ and solve the equation without adding the constants, we would obtain

$$y = 1 + 1 = 2;$$

hence the value for λ would not give two particular integrals but only one, for $1 = 1$. Thus by introducing C_1 and C_2 we make our integral complete. From the very first pages of these articles we remember that the roots of the quadratic equation can be real or imaginary, according to whether the determinant is positive or negative; thus, we must investigate here which value is the greater one, q^2 or k^2. Now, we know that k^2 or $\frac{p}{M}$ as corresponding to the motion of the mass without a resistance is always greater than q^2 or $\left(\frac{\rho}{M}\right)^2$ which corresponds to the motion with resistance; hence we must use the imaginary roots, and equation (158) becomes

$$y = C_1 \varepsilon^{-qt+jt\sqrt{k^2-q^2}} + C_2 \varepsilon^{-qt-jt\sqrt{k^2-q^2}}$$

$$= \varepsilon^{-qt}\left[C_1 \varepsilon^{jt\sqrt{k^2-q^2}} + C_2 \varepsilon^{-jt\sqrt{k^2-q^2}} \right];$$

by replacing the exponential expressions in the brackets by trigonometrical functions, following the rules expressed by equations (108) and (109), we obtain

$$y = \varepsilon^{-qt}\left[C_1 \cos t\sqrt{k^2-q^2} + C_1 j \sin t\sqrt{k^2-q^2} + C_2 \cos t\sqrt{k^2-q^2} - C_2 j \sin t\sqrt{k^2-q^2}\right]$$

$$= \varepsilon^{-qt}\left[(C_1 + C_2)\cos t\sqrt{k^2-q^2} - (C_2 - C_1) j \sin t\sqrt{k^2-q^2}\right] \qquad (159)$$

In this equation we must determine the constants C_1 and C_2; this we do by drawing conclusions from the physical problem we are investigating. Taking, for instance the galvanometer, we know that at the beginning of the oscillation, i. e., where $t = 0$, the deflection $= y_0$. Putting $t = 0$ in equation (159), we have $y_0 = C_1 + C_2$, for $\cos 0 = 1$ and $\sin 0 = 0$; for $t = 0$ we also

have $\frac{d y_0}{d t} = 0$; differentiate (159), introducing y_0 for $C_1 + C_2$ and designating for convenience sake $(C_2 - C_1) j$ by n and $\sqrt{k^2 - q^2}$ by m, then by application of equation (30)

$$\frac{d y_0}{d t} = [y_0 \cos t m - n \sin t m] \frac{d \varepsilon^{-q t}}{d t}$$
$$+ \varepsilon^{-q t} \frac{d [y_0 \cos t m - n \sin t m]}{d t} = 0$$

but $\frac{d \varepsilon^{-q t}}{d t} = - q \varepsilon^{-q t}$ by equation (155),

$\frac{d y_0 \cos t m}{d t} = - y_0 m \sin t m$ by note to equation (62) and by equation (89),

and $\frac{d n \sin t m}{d t} = n m \cos t m$ by note to equation (62) and by equation (88); hence,

$$\frac{d y_0}{d t} = - q \varepsilon^{-q t} [y_0 \cos t m - n \sin t m]$$
$$+ \varepsilon^{-q t} [- y_0 m \sin t m - n m \cos t m] = 0$$
$$= \varepsilon^{-q t} [- q y_0 \cos t m + q n \sin t m - y_0 m \sin t m - n m \cos t m] = 0$$
$$= \varepsilon^{-q t} [(- q y_0 - n m) \cos t m + (- y_0 m + q n) \sin t m] = 0;$$

dividing both sides by $\varepsilon^{-q t}$, we have

$$(- q y_0 - n m) \cos t m + (q n - y_0 m) \sin t m = 0.$$

Now, for $t = 0$ we have $\sin t m = 0$, but $\cos t m = 1$; to make $(- q y_0 - n m) \cos t m = 0$, we must have $- q y_0 - n m = 0$; hence

$$n = (C_2 - C_1) j = - \frac{q y_0}{m} = - \frac{q y_0}{\sqrt{k^2 - q^2}};$$

Therewith equation (159) becomes

$$y = \varepsilon^{-q t} [y_0 \cos t \sqrt{k^2 - q^2} + \frac{q y_0}{\sqrt{k^2 - q^2}} \sin t \sqrt{k^2 - q^2}]$$
$$= y_0 \varepsilon^{-q t} [\cos t \sqrt{k^2 - q^2} + \frac{q}{\sqrt{k^2 - q^2}} \sin t \sqrt{k^2 - q^2} \qquad (160)$$

Now let t take the values from $t = 0$ to $t = T$; then we have this time

$$T \sqrt{k^2 - q^2} = T \sqrt{\frac{p}{M} - \left(\frac{\rho}{M}\right)^2} = 2 \pi$$

(where we had with the sine motion before $\sqrt{\frac{p}{M}}\,T = 2\,\pi$) for a complete cycle. Substituting this value in (160) we get

$$y = y_0\,\varepsilon^{-qt}\left(\cos 2\,\pi\,\frac{t}{T} + \frac{q\,T}{2\,\pi}\sin 2\,\pi\,\frac{t}{T}\right) \qquad (161)$$

Now when $t = 0$ we have $y = y_0$, as deflection of the galvanometer, for instance; with increasing t the needle swings toward the position of equilibrium and y decreases; when $t = \frac{T}{2}$ we have

$$\cos\frac{2\,\pi\,t}{T} = \cos\pi = -1 \text{ and } \sin\frac{2\,\pi\,t}{T} = \sin\pi = -0;$$

hence

$$y = -y_0\,\varepsilon^{-q\frac{T}{2}};$$

when $t = T$, we have

$$\cos\frac{2\,\pi\,t}{T} = \cos 2\,\pi = 1 \text{ and } \sin\frac{2\,\pi\,t}{T} = \sin 2\,\pi = 0;$$

hence

$$y = y_0\,\varepsilon^{-q\,T} = y_0\,\varepsilon^{-q\frac{2\,T}{2}};$$

when $t = \frac{3\,T}{2}$, we have

$$\cos\frac{2\,\pi\,t}{T} = \cos 3\,\pi = -1, \text{ and } \sin\frac{2\,\pi\,t}{T} = \sin 3\,\pi = -0;$$

hence

$$y = -y_0\,\varepsilon^{-q\frac{3\,T}{2}}$$

. . . .

Let us collect the values thus found in a table, thus:

t	y
0	y_0
$\frac{T}{2}$	$-y_0\,\varepsilon^{-q\frac{T}{2}} = y_1$
T	$y_0\,\varepsilon^{-q\frac{2T}{2}} = y_0\,\varepsilon^{-q\frac{T}{2}-q\frac{T}{2}} = -y_1\,\varepsilon^{-q\frac{T}{2}} = y_2$
$3\,\frac{T}{2}$	$-y_0\,\varepsilon^{-q\frac{3T}{2}} = -y_0\,\varepsilon^{-q\frac{T}{2}-q\frac{T}{2}-q\frac{T}{2}} = -y_2\,\varepsilon^{-q\frac{T}{2}} = y_3$
$2\,T$	$y_0\,\varepsilon^{-q\frac{4T}{2}} = y_0\,\varepsilon^{-q\frac{T}{2}-q\frac{T}{2}-q\frac{T}{2}-q\frac{T}{2}} = -y_3\,\varepsilon^{-q\frac{T}{2}} = y_4$
. . .	. . . .

This table shows that $y_0, y_1, y_2, y_3 \; . \; . \; . \; . \; .$ differ by the factor $\varepsilon^{-q\frac{T}{2}}$. Plotting these values of y in a curve, taking the values of T as abscissæ and the values of y as ordinates, we obtain a curve as represented in Fig. 32. Drawing also curves through positive and negative amplitudes, we find that the ordinates of these two curves decrease like the terms of a progression, the curve through the positive amplitudes having the equation

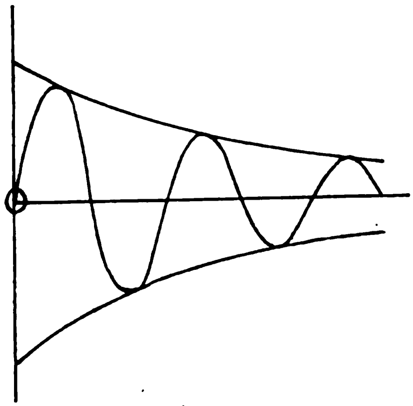

FIG. 32.

$$y = -y_0 \varepsilon^{-q\frac{T}{2}} \qquad (162)$$

and the curve through the negative amplitudes having the equation

$$y = -y_0 \varepsilon^{-q\frac{T}{2}} \qquad (163)$$

We have deduced the purely harmonic motion and the purely oscillating motion. Sometimes we have a combination of the two, namely, at the closing of a circuit with impedance, because impedance is an apparent increased resistance, and therefore at the closing of the circuit an oscillatory motion sets in, until the current settles down to its harmonic motion. This phenomenon will be discussed at the proper time.

Electrical Engineering
And Telephone Magazine

THE ONLY INDEPENDENT TELEPHONE PAPER IN THE WORLD.

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CHICAGO, AUGUST, 1898.

WITH this number ELECTRICAL ENGINEERING appears under a new ownership, a new management, and in a new and improved form.

Mr. DeLand has disposed of his entire interests in ELECTRICAL ENGINEERING, as well as in the Electrical Engineering Publishing Company, and is no longer connected with either the magazine or the company. The new owners will inaugurate a policy differing in many respects from that followed by its former proprietor. While the paper will continue to be a record of general scientific progress, one of its principal objects will be to give from month to month, in an impartial and unbiased manner, accurate information of the advancement and progress made in the independent telephone field throughout the United States. It will champion and defend the cause of the independent telephone interests to the best of its ability, without resorting to any but legitimate and dignified methods.

There is not now, and there will not be, as long as the magazine continues under its present ownership, anyone connected with it, in any capacity whatsoever, who is in any way, financially or otherwise, engaged or interested in the manufacture or sale of telephone or similar apparatus, or in the operation of an exchange.

With a firm and honest purpose of carrying out the policy outlined above, we confidently ask the generous support of the electrical and kindred trades in general and the independent telephone companies in particular.

C. E. KAMMEYER.

THERE seems to be more or less misunderstanding on the part of independent telephone companies and the public in general as to the scope and effect of the recent decision of Judge Buffington in the case of the Western Electric Telephone Company against Millheim Electric Telephone Company and others. While the decision rather broadly sustains the patent, it does not by any means follow that "the independent companies, if not utterly destroyed, will be seriously affected," the way an inspired Eastern paper puts it. The patent merely covers the particular form of apparatus described in Mr. Carty's specifications, and does not prevent the use of several other systems and style of apparatus now made and sold by telephone manufacturers. Neither does this decision finally dispose of the patent; other suits may have to be brought in order to sustain it, and in the defense of such suits entirely new testimony will be introduced which, through an unfortunate combination of circumstances, could not be made use of at this time.

"ELECTRICAL ENGINEERING" CHANGES OWNERSHIP.

As already announced in the *Electrical Review*, the Chicago monthly, ELECTRICAL ENGINEERING, has been sold by its former proprietor, Mr. Fred DeLand. The new owner is Mr. Carl E. Kammeyer, until recently and for several years past the Western representative of the *Electrical Review*.

Mr. Kammeyer expects to publish the August number between the first and the eighth of the month. He outlines his policy as follows:

"My intention is to publish the paper as an independent, dignified electrical journal, whose principal object will be to champion the cause of the independent telephone interests, without resorting to the rabid and ultra-violent methods used by its former owner in behalf of the Bell Company. There is not now, and will not be, anyone interested in the paper who is in any way, financially or otherwise, interested in the manufacture of telephone apparatus or the operation of an exchange."

Mr. Kammeyer is a good newspaper man, and has had a great deal of practical electrical experience. In embarking in his new enterprise he has the best wishes of the *Electrical Review*, and, doubtless, of his many friends throughout the electrical field.

[From the *Electrical Review*, New York, the oldest electrical weekly in the United States.]

IMPORTANT TELEPHONE DECISION.

TELEPHONE COMPANIES MAY SET POLES AS THEY LIKE.

A most remarkable decision was given by Judge Burnell on July 26 last, sitting in the Circuit Court at Milwaukee, under which telegraph or telephone companies have the right to erect poles in any street or highway without asking permission of the city authorities. It is further decided that the companies can put poles where they please without consulting the convenience of property owners. This extraordinary decision was brought out by an application of a taxpayer of Neenah, asking that the telephone company be enjoined from putting a pole in front of his store. An appeal to the State Supreme Court will be taken.

IN the last issue of ELECTRICAL ENGINEERING appeared an article in which the name of the Strowger Company happened to be so mixed up with that of Mr. Charles M. Feree and his defunct Harrison Telephone Company as to make it appear that both were one, or using the same system. We learn that the Strowger Company never had any connection with Mr. Feree, the Harrison Company, nor their system, hence this correction.

MR. CARTY IS HEARD FROM.

Mr. J. J. Carty, chief engineer of the New York Telephone Company, has had himself interviewed by the New York *Evening Post*, and in its issue of July 27 last makes, among other inaccurate statements, the following: (The italics are ours.)

> So this decision will affect only the companies doing business with a comparatively large number of subscribers, over a wide territory. The effect of the decision is, however, far-reaching. In the Southern and New England States, and in this State, there are very many small telephone companies doing a profitable business — the so-called independent companies. Their managers, I believe, concede that without the use of the Carty bridging bell they cannot give a satisfactory service to their subscribers. *At any rate, I know this to be so.* The Carty patent is one of the few devices that are *absolutely inseparable*, so far as is now known, from the perfect telephone. Enjoined from its use, the companies will be forced to go back to the days when telephonic communication was hardly possible

because of a confusion of noises, or to make some arrangement giving them the right to the use of the patent. The decision is a broad one. The patent is unqualifiedly sustained and the injunction absolute. It is now practicable to proceed against the infringing companies one by one, to collect damages, and to enjoin them all.

Well, well, so there really are "very many small . . . so-called independent companies." Mr. Carty should have completed his statement by adding that there are also *very many large* independent companies doing a profitable business. But when Mr. Carty intimates that such companies cannot give a satisfactory service without the use of the Carty bridging bell, he either makes a willful misstatement or is ignorant of the state of the art, which, in an engineer of such undoubted ability, seems hardly credible.

If Mr. Carty will glance over the advertising pages of the TELEPHONE MAGAZINE, he will find a number of solid, substantial, reputable telephone manufacturers who offer to furnish improved apparatus, in no way infringing Mr. C.'s pet patent, and perhaps superior in operation to the Carty system.

Neither will it "be practicable to proceed . . . and enjoin them all." While it is probably true that a few independent exchanges have been using bells made similar to the "Carty," the great majority of them long ago adopted noninfringing apparatus. Mr. Carty should come West and get posted.

THE American Electric Telephone Company, Chicago, is installing a complete telephone system throughout the Kalamazoo (Mich.) Asylum. Sixty instruments, all of the long-distance type, will be used, and the circuits made metallic, which, with other late improvements of the American Company, will make the plant a modern one in every respect.

TELEPHONE SWITCHBOARD LITIGATION.

INJUNCTION ASKED BY WESTERN ELECTRIC COMPANY AGAINST KELLOGG SWITCHBOARD AND SUPPLY COMPANY DENIED.

In the United States Circuit Court of Chicago, on July 29 last, Judge Showalter denied the preliminary injunction asked by the Western Electric Company, restraining the defendant company from installing a switchboard for the Kinloch Telephone Company, of St. Louis. The Kinloch Company is getting ready for service one of the largest independent telephone exchanges yet constructed, and the granting of the injunction would, no doubt, have caused serious delay in the opening of the exchange.

The application for the injunction was based on the Firman patent, which expires on January 19 next year. Its validity had been recently sustained by Judge De Haven in the Northern District of California, from which decision an appeal has been taken to the United States Circuit Court of Appeals. It was this decision upon which the complainant relied in asking for the injunction, seeking thereby to prevent the Kinloch Company from opening its exchange.

Affidavits from Prof. Elisha Gray, Professor Carhart, of Ann Arbor, Milo Kellogg, and F. W. Dunbar, claimed that there was no infringement. Prof. D. C. Jackson, of Madison; Thomas D. Lockwood, of the Bell Company, and C. E. Scribner, of the Western Electric Company, thought there was.

The Court stated in substance that it was his impression that there was no invention in the Firman patent; that he was unable to see upon what ground Judge De Haven had sustained the validity of the patent, in view of the prior state of the art, and especially in view of the Dumont English patent of 1851, and advised counsel for complainant that, in his opinion, if the case went to the Circuit Court of Appeals, they would have great difficulty in sustaining that opinion.

He also stated that one of the decisions cited by Judge De Haven in his opinion had been discredited by the Circuit Court of Appeals of this Circuit

in an opinion filed but a few days ago, and that it was very doubtful, to his mind, whether there was any invention in the Firman patent, or, if there was invention, it was extremely doubtful if defendant infringed. He said, however, that he preferred to place his decision at this time broadly upon the principle that the telephone company at St. Louis was engaged in a public service; that the question was doubtful; and that the defendant switchboard company was undoubtedly solvent, and would be able to pay any damages that might be recovered if the complainant should succeed in establishing the validity of the patent and the fact of infringement; and that it would, under such circumstances, and also in view of the early expiration of the Firman patent, be an abuse of discretion for him to entertain the petition for an injunction, which he therefore denied.

MICHIGAN TELEPHONE ASSOCIATION.

The Michigan Telephone Association, composed of the independent companies of the State, held its annual meeting at Grand Rapids on July 26 last. The meeting was well attended, representatives of all the larger exchanges and toll line companies were present, including those from Detroit, Saginaw Valley, Lansing, Kalamazoo, St. Johns, Owosso, Oceana, Montcalm, Stanton, and other parts of the State.

The most important business of the meeting was the discussion of rates and the thorough review of the present situation of the wires of the companies of the State, with especial reference to points between Muskegon and Indiana and between Grand Rapids and Detroit. A satisfactory conclusion was reached by the companies represented, so that it is entirely probable that active operations will be entered into immediately to complete the wires.

It was reported that the Detroit company has connections with some 150 towns, the city itself having over 5,000 telephones in operation, with some twenty toll line connections on the New State Telephone Company's lines. Reports of other independent exchanges were made, and the number of 'phones in operation by each was given. Arrangements were made to connect the various toll systems together and also to connect with Indiana and Ohio toll systems by long-distance lines, and the prospects for Chicago and Indianapolis connections by or before January are favorable. Two Indianapolis and one Fort Wayne delegates were present. Reasonable tolls were agreed upon and details largely arranged. Michigan has the largest two independent exchanges in the world in actual operation, and compares favorably with the other States in the number of telephones in service.

The recent action of the express companies, in insisting upon free telephone service for each agency, was another interesting matter brought up at the meeting. From reports of the representatives it appeared that while some of the telephone companies were furnishing free instruments to the express companies, the latter were gradually receding from their arbitrary position, and in many places, including Grand Rapids, were paying the regular rates, while the Bell was reported as furnishing free service in every case.

It is estimated that about 16,000 instruments are in use throughout the State, and this number is rapidly increasing. The new officers of the association are: J. B. Ware, Grand Rapids, president; Alex. H. McLeod, Detroit, secretary; and W. H. Tildew, St. Johns, treasurer.

RALEIGH, North Carolina, is to have a third telephone exchange company, composed entirely of local business men. Subscribers to all three exchanges may run short of desk room.—*Electrical Review.*

RHEOSTATS.

Probably no one concern has devoted so much time and money to the perfecting of one particular line of apparatus as the Cutler-Hammer Manufacturing Company, in the development of its rheostats and other resistance devices.

Today the company's line includes about everything in the way of starting

AUTOMATIC STARTING BOX.

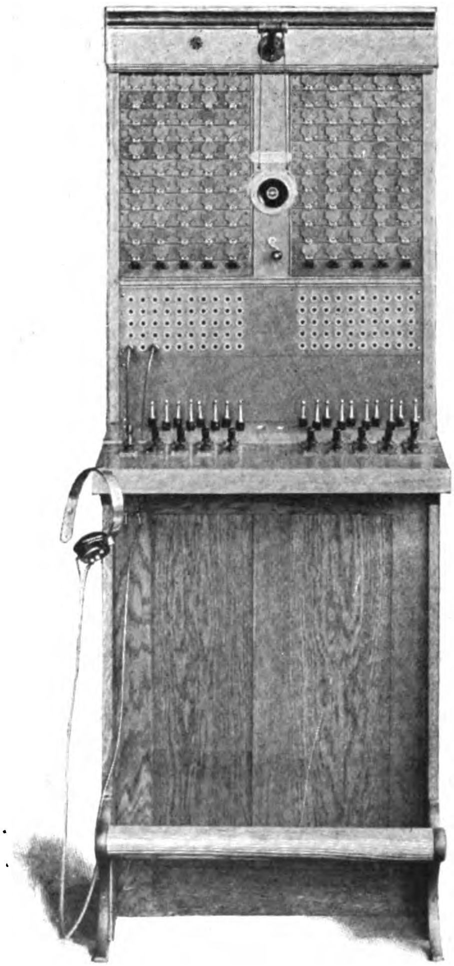
boxes, speed regulators, field rheostats, crane controllers, pump and elevator starters, that during five years of practical experience has been found necessary or desirable by the user. Particular attention has always been given to the automatic features of the company's devices, making them automatic in the fullest sense of the word.

THE STERLING ELECTRIC COMPANY.

In the manufacture of the most modern and efficient appliances that enter into the equipment, operation and protection of a telephone exchange, the Sterling Electric Company, Chicago, for about a year past has been more than successful in producing apparatus which would satisfy the most critical in points of technical and mechanical detail.

While some years ago the exchange manager would be satisfied to obtain apparatus almost "as good as the Bell," today he not only expects it as good, but generally gets it a little better. To give in detail a description of the various types and kinds of exchange and line apparatus made by this company, space will not allow.

In the Sterling switchboards, of which a standard 100 line is shown in the illustration, can be found a combination of



STERLING 100-DROP SWITCHBOARD.

all desirable points which years of experience have taught the company to be necessary and expedient. A correct and complete idea of the scope and variety of the company's products can only be gathered from its illustrated catalogue, which should be on the desk of every exchange manager.

THE paper that is most carefully read is the paper that yields the best returns to the advertiser.

THE WILLIAMS MAGNETO BELL.

Probably to no one piece of apparatus, entering into the equipment of a telephone line, has the electrical engineer given more thought and study than to the magneto bell. To make it the most simple, efficient and durable, has been his aim ever since the earlier crude devices were from time to time offered to the exchange manager, with the manufacturers' assurance that it was the best on the market. Possibly it was — in those days.

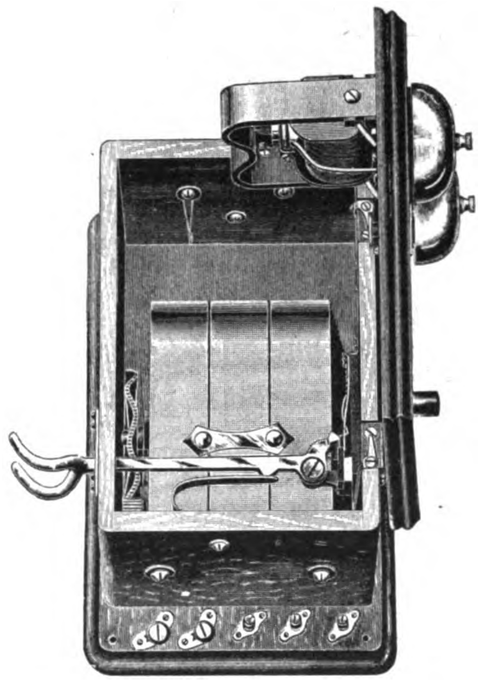
Among the several designers and inventors in this particular line, few are better known to the trade than Mr. J. A. Williams, engineer of the Williams Electric Company, Cleveland. One of the latest and best results of Mr. Williams' ability as a designer and practical electrician is now being offered to the telephone trade in the shape of a new magneto bell, a general view of which is given herewith. In this bell have been incorporated such a number of improvements in the several parts as to make the entire magneto undoubtedly the most efficient on the market today.

The magnets are held to the pole-pieces by brass bolts, and the arrangement is such that there is no space between the central and the outer magnets so as to utilize all of the space on the pole-pieces radially adjacent to the armature. The magnetic field is composed of three powerful horseshoe magnets, which are three-eighths of an inch in thickness and one and one-quarter inches in width, and are highly polished and nickel plated.

The method of taking the magnetism from the permanent magnets and distributing it uniformly around the cylindrical surface of the pole-pieces is very ingenious and is done by means of two contact plates, each of which has two ears turned inwardly to hold the plate in its position on the pole-piece, and has also four ears turned outwardly to hold the permanent magnets rigidly in their proper position on the generator. The end plates, which hold the shaft bearings, are punched from heavy brass, and have riveted into them very long brass bearings, which is an important feature toward making the machine run quietly for a long time.

In the driving gear an entirely new principle in gearing is employed. It is placed on the left-hand side of the generator, so as to avoid unequal wear on the gear bearings caused by turning the crank. This feature obviates the disagreeable noise caused by the unequal wear of the gear bearings due to operating the crank. With this construction the proper center distance between the gear shaft is maintained indefinitely.

The gear is made from a brass punching, radially corrugated, the object being



WILLIAMS MAGNETO BELL.

to provide a driving gear that will distribute its tooth surface over the surface of the pinion in a uniform manner, doing away with noise and giving long life. This gear, it is asserted, will not only last longer, but will run quieter during its life than will a wide-face, cast cut gear, for the following reasons: Owing to the exact equality of the tooth surface of both the gear and pinion, the wear on each of them will be precisely the same, in spite of the difference in their diametrical sizes. The effect of wearing at the same rate will maintain to a greater extent the proper curves of

the teeth of both the generator and pinion, causing them to roll one upon the other, instead of sliding and grating.

Owing to the peculiar construction of the pole-pieces, the resulting wave of current approaches very closely the sinusoidal form, which is very useful in transmitting signals over long leaky lines, having a high coefficient of self-induction or static capacity, thus making this instrument ideal for toll-line work.

In the ringer another new departure has been made, it having but a single core, which is parallel with the vibrating armature. The permanent magnet of the ringer is of the consequent pole type, and has the armature suspended from the central and consequent pole.

In designing this bell every point entering into the construction of magnetos has been carefully considered, and every defect developed in existing forms has been studiously avoided and ingeniously remedied. In fact, the object of the designer seems to have been to construct a magneto bell that would last indefinitely, with but few repairs, and so constructed that all necessary repairs can be made with the slightest possible loss of time or cost of material. This company is also designing a bridging bell system that they will shortly have ready for the market, which, it is claimed, will be clear from all possibility of infringement of the Carty patent, being at the same time fully as efficient.

A 100-MILE TRANSMISSION PROJECT.

The plan for the utilization of a part of the power of the waterfall of Elfkarleby, one hundred miles from Stockholm, has taken definite shape, according to a German paper. It is proposed to begin by using 20,000 horse-power, the estimated cost being given as follows: including all the machinery and works, $890,000; transmission line $1,165,000, making a total of $2,200,000. The full load loss is estimated at 25 per cent, and the available power for rental at 15,000 horse-power, the price being fixed at a little over $11 per year per horse-power. This would give an annual income of $165,000, or 7½ per cent on the investment, provided all available power was taken.

ACETYLENE.

Notwithstanding the attempt on the part of nearly all electrical and kindred journals to belittle the effect of the new illuminant, acetylene, on the electric lighting industry, it is nevertheless a fact that sooner or later it is destined to cover a considerable portion of the lighting field. Especially is this true of the smaller installations, where, with the introduction of practical gas generators and burners, which are being rapidly perfected, together with the present supply and market price of carbide, the gas man finds a profitable field of operation.

The subject of acetylene will be of great interest to the central station manager, and ELECTRICAL ENGINEERING will, in the next number, begin a series of articles covering the manufacture and output of carbide, the development and introduction of generators and accessories, thereby giving to the central station manager information which will be of great service to him, in so far as acetylene may affect his earnings, which of course is his first consideration.

STORAGE BATTERIES FOR THE SOUTH SIDE ELEVATED ROAD, CHICAGO.

The Electric Storage Battery Company, seemingly not content with the honor of having installed the largest battery in the world used in a lighting station, last week closed a contract with the South Side Elevated Railroad Company, of Chicago, for two batteries, each of 500 kilowatts capacity. One of these batteries will be installed on the company's property at Twelfth street, and the other at Sixty-first street, and will be used to regulate the fluctuations of the load, and to maintain an even potential at extreme points on the line. Both batteries will be installed with tanks and bus-bars of sufficient size to permit of doubling the capacity, should that be found to be desirable.

These batteries, when completed, will comprise the largest storage battery installation for railway feeder regulation in this or any other country. The first set of batteries is expected to be ready for use by September 15 next.—*Electrical Review*, *New York*.

AMERICAN STREET RAILWAY ASSOCIATION.

Judging from the completeness of the arrangements made for the meeting and exhibition of the American Street Railway Association, to be held at Boston from September 6 to 9, this year's gathering will prove, perhaps, the most successful and enjoyable one in years. Nearly all the leading manufacturers have secured exhibition space, nearly 25,000 square feet being engaged.

From the West the delegation will be unusually large, special accommodations having been arranged for between Chicago and Boston. The Wabash Railroad will start its beautiful train, the "Continental Limited," from the Polk street depot at 12:02 noon on Sunday, September 4, arriving at Boston Monday at 5:50 P.M. There will be a special sleeper for ladies and members taking their families.

At Detroit, that city's members will be taken on board, and from there east the train will stop at various points for the Eastern delegates. At Montpelier the St. Louis train is joined to the Limited, so that altogether the Western contingent will be quite numerous.

The following is the programme of papers to be read and discussed at the meeting:

1. "Maintenance and Equipment of Electric Cars for Railways," by M. S. Hopkins, Electrician Columbus Street Railway Company, Columbus, Ohio.

2. "To What Extent Should Railway Companies Engage in the Amusement Business?" by W. H. Holmes, General Manager Metropolitan Street Railway Company, Kansas City, Missouri.

3. "The Carrying of United States Mail Matter on Street Railways," by W. S. Dimmock, General Superintendent Omaha & Council Bluffs Railway and Bridge Company, Council Bluffs, Iowa.

4. "The Comparative Earnings and Economy of Operation Between Single and Double Truck Cars for City Use," by Richard McCulloch, Electrical Engineer, Cass Avenue and Citizens Railway Companies, St. Louis, Missouri.

5. "Inspection and Testing of Motors and Car Equipment by Street Railway Companies," by Frederick B. Perkins, Electrical Engineer Toledo Traction Company, Toledo, Ohio.

6. "Cost of Electric Power for Street Railways at Switchboard, both Steam and Water," by R. W. Conant, Electrical Engineer Boston Elevated Railway Company, Boston, Massachusetts.

WHAT THE LAW DECIDES.

THE internal management of a foreign corporation is held, in Madden *vs.* Penn Electric Light Company (Pa.), 38. L. R. A. 638, to be beyond the power of a court to interfere with at the suit of a resident stockholder, although the visible, tangible property of the company is in the State.

AN important case as to the legislative power to fix rates for a corporation is that of San Diego Water Company *vs.* San Diego (Cal.), 38 L. R. A. 460, holding that an ordinance fixing water rates is invalid if they are so palpably unreasonable and unjust as to amount to a taking of property without just compensation, and that rates which will pay but little more than three and one-third per cent on the actual cost of the works, after deducting current expenses, are too little, where the company is compelled to pay a much higher rate upon money which it has borrowed fairly and prudently.

PROBABLY THERE WAS.

At the last meeting of the city council one of the aldermen read some letters going to show that telephone companies did best where there was no competition, and that where the Bell Telephone Company was alone there was no complaint of the service. That has nothing to do with the case here. There are two distinct propositions. One promises good service to the citizens for forty per cent less. Is there a business man in the council who would hesitate for a moment as to which proposition he would accept if he were doing business for himself and not for the city?—*Peoria (Ill.) Herald.*

THERE is not a business that cannot be helped by advertising. There is likewise a profitable method for advertising every business.—*Adology.*

RECENT PUBLICATIONS.

"In the type-case of the printer, all the wisdom of the world is contained, which has been or ever can be discovered. It is only requisite to know how the letters are to be arranged. So, also, in the hundreds of books and pamphlets which are every year published about ether, the structure of atoms, the theory of perception, as well as on the nature of the asthenic fever and carcinoma, all the most refined shades of possible hypotheses are exhausted, and among these there must necessarily be many fragments of the correct theory. But who knows how to find them?

"I insist upon this in order to make clear to you that all this literature, of untried and unconfirmed hypotheses, has no value in the progress of science. On the contrary, the few sound ideas which they may contain are concealed by the rubbish of the rest; and one who wants to publish something really new — FACTS — sees himself open to the danger of countless claims of priority, unless he is prepared to waste time and power in reading beforehand a quantity of absolutely useless books, and to destroy his readers' patience by a multitude of useless quotations."—HELMHOLTZ.

ELEMENTS OF THE DIFFERENTIAL AND INTEGRAL CALCULUS, WITH APPLICATIONS. By William S. Hall, E.M., C.E., M.S. Second Edition. New York: D. Van Nostrand Company, 1898. 249 pages, 6 by 9; 44 diagrams; price, $2.25 net.

A new treatise on the Calculus, to be received with favor, must, in some sense, be unlike those that have preceded. It may, for example, be more complete and exhaustive, be written in an unusually attractive style, or be presented with unequaled simplicity and clearness. A careful examination of Professor Hall's "Elements of the Differential and Integral Calculus" shows that the cordial reception of the first edition of the work is in large measure accounted for by its lucidity and terseness, while still of sufficient fullness for the purposes of those who have occasion to use this most valuable branch of mathematics. The principles of the subject and the rules to be employed are stated in well-considered terms, no words being wasted in entertaining the reader, or in endeavoring to persuade him that he is engaged upon anything but calculus. Much space is saved by treating the two branches of the subject together, the processes of integration being taken up immediately after the formulæ for differentiation are derived. This not only considerably shortens the work, but by indicating how artificial is the subdivision of the subject into two distinct treatises, serves both to the formation of clear conceptions and to the lightening of the burden imposed upon the memory.

The usual matter to be found in works on the Calculus is, in this book, presented in brief and comprehensive chapters. The examples are numerous, and well selected and illustrative. In addition to the more common applications of the Integral Calculus, many problems in Center of Mass, Moment of Inertia, and general Mechanics are worked out, while other important uses are referred to.

Of especial interest and value to electrical engineers is the concluding chapter on differential equations. This should prove of great assistance to those who are struggling with the theory of alternating currents, so largely in evidence at the present time. Complete and well-classified tables of integrals are inserted as an appendix.

To those who wish to review the Calculus, long since forgotten by them, as well as to others desiring simply a convenient reference book, no more suitable work than the one under consideration can be suggested.

CHAUNCEY G. HELLICK.

LEHRBUCH DER EXPERIMENTALPHYSIK. Von Adolph Wüllner. III Band.—Die Lehre vom Magnetismus und von der Elektricität, miteiner Einleitung Grundzüge der Lehre vom Potential. Leipzig: B. G. Teubner, 1897. 1414 pages, 6 by 9; 341 illustrations; paper, uncut; price, 18 marks.

The first and second volumes of this great work on experimental physics have been reviewed on a previous occasion. At that time we mentioned that this treatise was above criticism, a statement we repeat today. A work

like this, to reach its fifth edition, must be comprehensive and complete; for it involves no end of hard and painstaking study to keep up with the times in a science that covers such a wide ground as physics does. This third volume follows historical lines in so far as it records the fundamental experiments, but we find again and again modern investigations inserted, either to show the fallacy of old conceptions, or to throw new light upon experiments that were not fully understood or explored at the time when first made.

In the introduction on the potential, which is of a purely theoretical, not to say mathematical nature, the student is agreeably surprised by lucid explanation and clear mathematical deductions. Green's theorem, the central point around which the theory of potential revolves, draws a seemingly impenetrable fence of triple integrals around the subject which shuts the non-mathematician out; but there is no fear that the reader possessing a little courage and some industry may climb the fence if he follows Wüllner's discussion; everything is so plainly deduced, there is no "obvious," nothing but uninterrupted conclusions. The extension of Green's theorem leads easily to Faraday's lines and tubes of force. The introduction ends with the determination of the energy expended in the displacement of given electrified bodies from the potential, with the final conclusion that the sum of potential and kinetic energy is constant, which law is the principle of the conservation of energy.

In the first chapter of the first part the theory of potential is applied to, or rather paralleled by, the magnetic potential, following a historical sketch of the magnetic property and the actions of magnets. Gauss' researches take the lead in the discussion. The influences that magnetic force and heat have upon the magnetism are touched upon at the end of this chapter. The relations between torsion and magnetism, which form such interesting reading in Wiedemann's electricity, are shortly referred to. The second chapter, on terrestrial magnetism, relates declination and inclination familiar to the astronomer, weatherman and navigator, but of little interest to the practician, who values the earth mostly for its property of furnishing a good and substantial ground.

With the second part the author enters the wide field of electricity, making a start with frictional electricity. Though the subject matter is old (the gold leaf electrometer, torsion balance and other acquaintances from the shelves of the physical laboratory parading again before our eyes), novelties enliven their study. Thomson's method of electrical images for finding the distribution of electricity, though not of recent date, is always interesting. The author allows it a few pages only; the student inclined to more extensive study must search the original papers. The description of electrometers and the manner of their application to measurements that follows is exhaustive.

The first traces of the stirring researches inaugurated by Faraday and continued by Maxwell, Hertz, Lenard, Boltzmann, Crookes, Roentgen and others, who revolutionized the theories of electricity as well as of light, we find in the chapter on the dielectric. The determination of the dielectric constant, the study of partial discharges and their velocities, of the residue in batteries, of the light effects in electric discharges are the stepping stones to the electro-magnetic theory of light.

The third part, entitled "Galvanism," contains 450 pages, pervaded by the animus of the present decade. Batteries have been for a long time the only means of current supply, and by the observation of the actions in the same the fundamental laws of electricity have been established. Ohm, as far back as 1827, found the law upon which the entire electrical industry

is built, and which he had formed from the observation of the process going on in the galvanic battery, but a complete theory of the chemical actions in the same is not fully established yet. Faraday's laws of electrolysis gave the impulse to a science which today claims a sphere of its own, namely, to electro-chemistry. Though Grotthus established a theory of electrolysis as far back as 1805, opinions have differed ever since. Lately, Nernst presented a theory, based upon van t'Hoff's theory of osmotic pressure, which explains a great many observations, though not all. Study in this direction occupies the mind of many of our ablest physicists.

Oersted observed first the actions of currents upon each other, and this opened a new field of investigation, which Wüllner explores in his chapter on "Electro-dynamics." Ampère's and Weber's names are connected forever with the first established laws governing these actions. The Hall effect also finds a place here; of the different explanations of the same, the author gives Boltzmann's theory. After an interesting description of galvanometers, electro-magnetism is gone into by discussion of magnetization by the galvanic current, the properties of electro-magnets and hysteresis. Here we find records of thoroughly conducted experiments for determination of the constants of permeability, etc. Daimagnetism forms the conclusion of this chapter — a theme probably dear to the scientific investigator, but as a rule neglected by the practitioner.

We come then to what has been the origin of our electrical industry, what has set millions of wheels in motion, namely, electric induction. The theory of induction as given by Neumann and by Helmholtz is shortly explained. Maxwell's equations for the electro-motive force of induction are deduced and Weber's theory shown to be in harmony with Neumann's. The dynamo is illustrated as means to apply induction to the generation of current. By way of the transformer and induction coil the author makes his way to the discharge of current and the light effect connected therewith. We now arrive at a point where the reading gains immensely in fascination. Beginning with the conduction of gases as illustrated in Geissler tubes, in which the pencil of positive light preponderates, the author soon passes over to the negative light, kathode rays and X-rays. The fourth chapter, then, is devoted entirely to electric oscillations, Hertz being the hero, who had to end his fruitful career much too soon, leaving to others the task to penetrate deeper and deeper into nature's secrets, following the direction Hertz had pointed out. Here ends the third volume, to which the fourth one, on light, will form a natural sequence.

F. J. DOMMERQUE.

INDUSTRIAL ELECTRICITY. Translated and adapted from the French of Henry De Graffigny and edited by A. G. Elliott, B.Sc. New York: The Macmillan Company, 66 Fifth avenue, 1898. 152 pages, 5 by 7; price, 75 cents.

This is the first of a series of volumes known as Whittaker's Electro-Mechanical Series, and intended for the general reader rather than the engineer. The volume is based on and adapted from the French work of De Graffigny, which has met with so cordial a reception that many thousands of copies are reported to have been sold. The little book opens with a presentation of the nature of electricity, an interesting and clear exposition of the units employed in electrical measurements, and an explanation of magnetism and of induction. Then follows descriptions in nontechnical language of the methods and means employed in the practical application of electricity in lighting, power, and railway and telephone plants, as well as in electro-chemical and electro-plating processes and in housework. It is an admirable work for the beginner in the electrical field.

F. DEL.

REFERENCE BOOK OF TABLES AND FORMULAS FOR ELECTRIC RAILWAY ENGINEERS. Compiled and arranged by E. A. Merrill, A.M., second edition. New York: The W. J. Johnston Company, 1897. 128 pages, 3½ by 5½; price, $1.

This revised and enlarged second edition of Merrill's Reference Book is admirably adapted for the class of engineers for whom prepared, for it presents in small compass and compact form and between the covers of an actual pocketbook about all the tables that the local engineer may find occasion to refer to. The present edition is interleaved, thus affording convenient pages for adding new data and tables. F. DEL.

ELECTRIC TELEGRAPHY. By Edwin J. Houston, Ph.D., and A. E. Kennelly, Sc.D. New York: The W. J. Johnston Company, 1897. 448 pages, 5½ by 7; price, $1.

This eighth volume in the "Elementary Electro-Technical Series" possesses the same charm for the lay reader desirous of obtaining a non-technical and general yet comprehensive view of any particular branch of the electrical industry that is so noticeable a feature of all the earlier volumes. Some seventy-five pages are devoted to the subject of submarine telegraphy, and many details given that are especially interesting now that so many readers are anxiously scanning the bulletin boards and the extra editions of the daily papers for cablegrams that will give definite news of the safety or the movements of our troops, whether in the Philippines or in Cuba. How cables are made, how laid on the ocean bed, how grappled for when lost or broken, and how messages are transmitted, are features that are detailed in interesting and strictly nontechnical manner.

F. DEL.

"CATAPHORESIS," or, Electric Medicamental Diffusion as Applied in Medicine, Surgery and Dentistry. By William James Morton, M.D. New York: American Technical Book Company, 1898 267 pages, 6 by 9; 76 illustrations; price, $5.

Briefly, it is a comprehensive view of the application of electricity in modern dental practice from the broad plane where it merges into the confines of medical and surgical practice. The title is defined in the subtitle as electric medicamental diffusion, "the latter terminology expressing what will here be demonstrated and enlarged upon, namely, that electricity does diffuse liquids and substances throughout other liquids and substances and through soft and hard living tissues, including the hard tissue known as dentine."

The first fifty pages are devoted to a historical résumé of early investigations, practice and results. Then follows a clear exposition of the elementary electrical principles and a description of the "sources of electricity," illustrating the methods and the apparatus used. Simple or chemical osmosis, electrical osmosis or cataphoresis and electrolysis and cataphoresis are all defined and their relation to each other clearly explained.

The third section is devoted to an illustrated description of the apparatus used and the outfit required, including electrodes for medicamental diffusion, electrodes for metallic electrolysis and dental electrodes; batteries and central station circuits, rheostats or current controllers, and milliampere meters are interestingly described and their use explained. The section then closes with a list of the principal medicaments which have been found useful in cataphoretic applications.

The fourth section of the volume, consisting of 110 pages, is devoted to "Applications in Medicine and General Surgery." In the first chapter of this section the phenomenon of simple cataphoresis is considered; then the approved methods of securing cataphoric medication, or the specific

introduction of drugs or medicaments into living tissue, is discussed. In the first section of the volume the cataphoric use of cocaine to relieve the pain of neuralgia is treated in detail, while in this fourth section the use of cocaine cataphorically to produce a practical local anæsthesia sufficient for minor surgical operations is described in detail and clinical cases cited. The section closes with a chapter on electric diffusion from soluble electrodes.

The fifth section will probably prove most interesting to the progressive dentist, for therein is detailed the special applications of electricity in dental surgery. The anæsthetization of sensitive dentine is broadly treated, and the suggestion given that in combining guaiacol with cocaine a saving of two-thirds in time and in current strength is effected, the explanation being that the guaiacol combines chemically with "the cocaine and thus prevents any possible quick absorption into the general circulation with consequent toxic effects." Doctor Morton also calls especial attention to the fact that in applying electricity to a tooth the best results are secured where the cross-sectional area of the applicator nearly equals the cross-sectional area of the cavity to be treated; otherwise the cocaine may not be properly diffused into the dentine. The smallest possible quantity of current should be at first applied, and "even when anæsthesia has been obtained, a rate of two milliamperes is considerable."

"The anæsthetization of the gums so as to permit of tooth extractions and implantations and other similar operations" is briefly treated in the second chapter of the fifth section. Then follows a description of some experiments in the bleaching of discolored teeth by cataphoric medication, with notes of successful cases and causes of partial or complete failures. The principle of cataphoresis as an aid in the sterilization of dentine is broadly treated and the admission made that "present methods are only partly efficient." The volume closes with a chapter on the electric staining of tissue, showing the application of electricity in microscopical work.

F. DEL.

DETERMINATION OF THE FREQUENCY OF ALTERNATING CURRENTS. By Carl Kinsley. London: Taylor & Francis, Red Lion court, Fleet street.

This little pamphlet gives a method of determining the frequency of an alternating current by the use of a telephone held in front of a resonance tube. As the frequency is a function of the wave length of the note and the velocity of the sound, the determination of the length of the tube for the condition of maximum resonance gives the frequency. Tables are appended to give the frequencies at different temperatures from the observed length of the tube, the length being varied by a piston sliding in the same. This method should prove convenient in many cases.

F. J. D.

RECENT PUBLICATIONS.

HANDBUCH DER ELEKTRISCHEN BELEUCHTUNG. Von Jos. Herzog und C. P. Feldmann. Berlin: Julius Springer, 1898. 512 pages, 6 by 9; 428 illustrations, 4 large plates; cloth; price, — marks.

Electric lighting has now attained such enormous proportions that sufficient material for the production of a large volume on the subject is not wanting. But to so select and arrange the matter that it may be representative of the best practice, be modern and cover the ground completely without entering too much into details, is a difficult matter. That the authors are competent to give an account of the best practice may be concluded from the fact that the one until recently was in charge of the municipal alternating-current station at Cologne, a model station; while the other is chief engineer of Ganz & Co., in Budapest, which firm installed some of the most efficient plants in existence. We must also concede that the authors have written a practical book, not a picture book, but a well-illustrated exposition of all the economical features of an installation for electric lighting.

The treatise is modern in so far as it takes into account the practice up to 1898, and that the ground is well covered will be seen from the detailed account given below.

The first chapter, on sources of electric light, devotes 91 pages to the physical properties of arc and incandescent lights, going into their construction and economy and then into photometry. Here we notice that the authors have written for the engineer, to which class they assign the station manager, as explicitly stated in a subsequent chapter. Geometrical representation of observations and conclusions is recurred to most frequently, analytical mathematics are rare here, as well as throughout the book; now and then a simple expression or deduction appears that should be within the mental capacity of every engineer. Though European construction differs from ours, principles remain the same, and the authors took great care to study American practice, which is proved by their acquaintanceship with our current literature to which they frequently refer.

The second chapter, on line construction, divided into aërial and underground construction, illustrates in general the most practical methods. Across the Atlantic they do not hesitate to lay iron-armored cables directly into the ground, a custom well-nigh unknown here, while the use of terra cotta conduit is referred to as American practice only.

The third chapter, treating of the systems of distribution, is as instructive as it is simple. The matter is divided into line wiring and dynamo wiring. The authors state that Thomson's law does not take account of the function of current consumers, and thus in most cases the cross-section of conductors is not the best. This accounts for their not giving an account of Thomson's law. For the calculation of a network they apply the Herzog-Storm method, which they illustrate by an example (the network of Cologne is laid out after this method). Here as well as everywhere great attention is paid to alternating-current work.

Regulation is the subject of the fourth chapter. The elaborate cell-switching apparatus used in German central stations is more fully described, while dynamo regulation is marked as specifically American and described sufficiently complete for the purposes of a manual.

The first paragraphs of the fifth chapter, on auxiliary apparatus, are devoted to fuses and lightning arresters. It is wonderful how the rules and regulations for the maximum current allowable for fuses vary in the different countries. As an illustration we give the rules for Vienna, London and Paris.

Vienna: Maximum current $= 7.5\, d \sqrt{d}$
London: " " $= 10\, d \sqrt{d}$
Paris: " " $= 15\, d \sqrt{d}$

where $d =$ diameter of lead wire in millimeters. Under lightning arresters we meet again the divergent wires (in the shape of horns) that push the arc along and finally extinguish it, noticed in one of the electrotechnical library volumes edited by Hartleben. Two splendid photos are inserted, picturing such a lightning arrester short-circuited under a 10,000-volt alternating current. Switches are made short work of and we are glad of it; the somewhat extended description of high-tension switches is interesting enough to allow it the space given. Measuring instruments have to be satisfied with a few pages only, giving the principles underlying their action. Of electricity meters we find the Edison and the Thompson, besides some foreign ones of which the Aaron takes first place. Some minor apparatus follows to complete the list.

The chapter on insulation, coming next, gives some valuable information, and while the rules prescribed by the German electricians are not binding here, they are sound and well worth reading. The seventh chapter gives methods of supporting incandescent and arc lights; the illustrations show the tendency of the Germans toward decorative design.

Chapter VIII is the most voluminous and most valuable of the manual, treating the installations from the point of economy. The short but characteristic discussion of the prime movers gives an idea of what is demanded of them to suit the purpose of central station work. The diagrams illustrative of the cost and efficiency of German central station apparatus may not be applicable to American machinery; however, they are of great value, because they teach the station manager how to prepare and use diagrams of

this kind. Prices being variable, even a record of American machinery would not be of much more use.

The last chapter gives a full account of some installations with their plans attached. Whoever is possessed of ambition and reverence for his profession, will welcome such a manual as a means of profitable study to further his own interests and those of others.

As in all first editions, some typographical errors were overlooked, but they are not of a serious character. The charge of 1.6 pfg. per kilowatt hour for power service would be disastrous to an installation; probably 16 pfg. is meant (page 484).

F. J. DOMMERQUE.

VORLESUNGEN ÜBER TECHNISCHE MECHANIK. Von Dr. Aug. Foeppl. Dritter Band: Festigkeitslehre. Leipsic: B. G. Teubner, 1897. 472 pages, 6 by 9; 70 figures; cloth; price, 12 marks.

Professor Foeppl is an old acquaintance of ours, though he presents himself today in a new garb. We always knew him as the German Heaviside, propounding electro-magnetic theory and vector analysis; but that is only part of his work, for he holds the chair of mechanics at the Munich Technical University. He says that his students urged him to give them a text-book so as to make it easier to follow his lectures, and in order to meet their wishes he began to publish his lectures. Four volumes are to contain the entire matter, the third one to appear first as considered most needed. The first volume is intended as an introduction into mechanics, the second to treat graphic statics, and the fourth to treat dynamics. Perusing the book before us it is easily seen that the author is not only a professor but also an engineer; besides the development of the theory he has always an eye on its practical application, and there is probably no field of applied physics where the practice is of more importance than in elasticity. In this branch there are factors that can only be determined by tests, as, for instance, the strength of materials, and it is in this respect that the author has done much good, for he experimented upon subjects where valuable data are scarce. The reader may have expected to find an extensive application of vector analysis, as any matter where forces enter offers a good opportunity to the application of directed magnitudes, but the author did not see any advantage in deviating from Cartesian analysis. However, mathematics is not used to any great extent, i. e., higher mathematics, except in a chapter on the mathematical theory of elasticity, introduced to make the treatise complete. Differential and integral calculus in their principles should be known to every engineer. To express pressures, etc., in atmospheres is very commendable. All through the book examples are inserted and solved completely, not only to show an application of the theory, but to extend the text to some points that could not be shown up clearly enough otherwise.

On the whole, the treatment of the subject follows time-honored lines, but many chapters bear an entirely novel character. It just happens that one of the most interesting discussions is cut short at the end of the book, namely, the state of tension in loose earth and the calculation of earth pressure upon retaining walls. As this is a point where data are well-nigh absent, let us hope the author will discuss this matter more fully elsewhere. It might be well to give a list of contents, so as to enable the prospective student to form a picture of the variety of matter treated. The first chapter investigates the state of tension in general. The second chapter treats of the elastic change in form and the loads on material, while the third chapter develops the formulas for calculation of bending of the straight beam.

In Chapter IV the energy stored by change of form is calculated by the theorems of Castigliano and Maxwell's theory of displacement. In the fifth chapter, on beams with curved centerline, the author reviews the different opinions held upon this subject and then deduces the formulas for the solution of problems in that line. In the sixth chapter the author gives an account of his investigations upon beams with elastic support, which is of importance in railroad construction. Chapter VII treats of the strength of plane plates, supported around their entire circumference, and Chapter VIII of the strength of vessels under interior or exterior pressure. Chapter IX is devoted to resistance to torsion, and Chapter X to resistance to crushing. The rest of the book is given up to the theory of elasticity, held mathematically throughout, and giving with others also the theory of Hertz. At the end of the book all formulas are reprinted for easy reference.

F. J. DOMMERQUE.

A TREATISE ON MAGNETISM AND ELECTRICITY. In two volumes, by A. Gray. Cloth, 473 pp., 6 by 9, uncut. London: Macmillan & Co.; New York: The Macmillan Company, 1898.

The progress of scientific research is so rapid, and the field of investigation so broad, that it seems an almost hopeless task to attempt to produce a theoretical and experimental treatise on such subjects as electricity and magnetism that shall be thoroughly abreast of the prodigious evolution of knowledge we observe about us, or at any rate to produce such a treatise as may long remain in the strictest sense modern. Professor Gray evidently felt this when, as he tells us, in preparing the second volume of his well-known "Absolute Measurements," he concluded that a rewriting of the entire subject seemed desirable.

The first portion of the rewriting afterward undertaken by him is now before us. Though some of the matter which it contains is to be found in the earlier productions of the author, the greater portion is new, and some of its features decidedly novel in a work of the kind. Noticeably so are the chapters on General Dynamical Theory and Fluid Motion. Throughout the book the endeavor is made to fix the attention of the reader upon the medium of propagation of the electric and

magnetic actions, and to refer such actions, transmitted at a finite velocity, to a state of strain of the medium. Recognizing the assistance to be derived from mechanical analogies, which the author uses whenever possible, he naturally turns to Maxwell's dynamical methods as the best adapted to the elucidation of the more abstruse portions of the subject. To this end, for the reader's convenience, and to obviate the necessity of his referring to a special treatise, is inserted the chapter on General Dynamical Theory. There are to be found a discussion of Lagrange's generalized coördinates, the ignoration of coördinates, and Lagrange's equations, containing gyrostatic terms, with an application to the gyrostatic pendulum. Hamilton's equations also are given, as well as Helmholtz's theorems of cyclic systems, in connection with dynamical analogies of thermodynamic relations. The intimate relationship existing between the theory of the motion of an incompressible fluid and that of electromagnetism, taken in connection with the indication that electro-magnetic effects are probably due to some kind of a vortex motion, has impelled the author to include a very complete chapter on Fluid Motion, with all of the more usual hydrodynamic theorems, ending with an exceedingly satisfactory discussion of vortices. Although requiring much space, the plan of the author is an excellent one, and should be of great assistance to the student endeavoring to master the electro-magnetic theory.

It is impossible to direct attention to all of the many good things contained in the different chapters, or to fully indicate the admirable manner in which they are presented. Reference can be made to but a few points. In the matter of symbols the author deviates slightly from established usage. Instead of allowing k and μ, as is customary, to denote respectively the specific inductive capacity and magnetic permeability, they are taken as standing for the electric and magnetic inductivities, k_0 and μ_0 being the corresponding quantities for the standard medium. What are commonly called the specific dielectric and magnetic inductive capacities then become the ratios $\frac{k}{k_0}$ and $\frac{\mu}{\mu_0}$, while k and μ are true physical quantities. The induction, electric or magnetic, as the case may be, is obtained by multiplying the field intensity by the inductivity.

In finding the electro-magnetic action of two finite current elements upon each other, the author shows how easily the objection that unclosed current-carrying circuits do not exist, can be met by assuming that the flow is made circuital by the displacement currents of Maxwell, these currents being directed radially outward at one end of the conductor and radially inward at the other end. By this means, the proposition is made strictly rigorous, while at the same time it enables one to separate the terms giving the direct mutual action of the elements.

A treatise like this would be incomplete without reference to the electro-magnetic theory, and we accordingly find set before us Maxwell's equations, and very copious excerpts from the memorable researches of Hertz, every reading of which but serves to increase the admiration one feels for the splendid genius that conceived and executed such epoch-marking investigation. As the author points out, it is not necessary to abandon Maxwell's theory in tentatively assuming the existence of vibrations in the direction of propagation of the disturbance, as has been done by some physicists in attempting to find a provisional explanation of the Roentgen rays, for the idea of "longitudinal light" follows directly from Hertz's equations.

The entire handling of the matter in the first volume is such as, combined with the author's promise of so many interesting and valuable topics to be included in the second, to make all who have had the pleasure of reading the present volume look expectantly for the early appearance of the sequel.

CHAUNCEY G. HELLICK.

A DREAM OF LUXURY.

Few specimens of the printer's art, perfect in typographical arrangement, faithful in reproduction of the artist's pen and painter's brush, have ever left the press, intended primarily for advertising purposes, that equal in daintiness and pleasing effect the brochure just issued by the Passenger Department of the Wabash Railroad. The "Continental Limited" is its title, and in it the management has succeeded in acquainting the traveling public, in a most happy manner, with the details which entered into the conception, completion and naming of the fastest train ever placed in regular service.

The booklet not only reflects the artistic taste of the author in the highest degree, but is at the same time a beautiful example of perfect execution in the way of designing, engraving and printing.

A DEBT for the purchase of an electric light plant for a municipal corporation is held, in Mayo *vs.* Washington (North Carolina), 40 L. R. A. 163, not to be one of the "necessary expenses" of the town which can be incurred without a vote of the majority of the qualified voters and legislative authority.

THE Battle Creek (Mich.) new exchange will have a complete Stromberg-Charlson Central Energy equipment.

INDEPENDENT ITEMS.

BOLIVAR, MO.—J. C. Pike and H. S. Bruce propose establishing a telephone system in this city.

BLAKELY, GA.—The Blakely Telephone Company will construct a line at once from Blakely to Bluffton.

BELLE PLAINE, IOWA.—The Chariton Telephone Company will extend its lines so as to have direct communication with Des Moines.

EPHRATA, PA. — The Independent Telephone Company, with headquarters at Lititz, expects to be in operation here in about three weeks.

ALEXANDRIA, MINN.—The Alexandria Telephone Company has been granted the right by the village council to put in a local telephone service.

FERGUS FALLS, MINN. — The new exchange has just been completed, and starts out with 100 subscribers and good prospects of an early increase to 150.

PEORIA, ILL.—F. A. and D. S. Chapman have applied to the city council for a telephone franchise. They represent the Automatic Telephone Exchange Company.

MANSFIELD, OHIO.—L. L. Stark, of this town, and his associates, who are prominent in Zanesville, are taking steps to organize an independent company in Zanesville, in opposition to the Central Union Company.

NEW RICHMOND, MINN. — A local telephone company is to be organized here, and the work of construction will be commenced in a few weeks. It is thought that at least seventy-five telephones can be put in at the start.

TERRE HAUTE, IND.—A provision in the charter of the two new companies gives the police department the free use of all the lines operated outside the city for a distance of ten miles. This will give the department a long-needed assistance in its general work.

CARLISLE, PA.— The Cumberland Valley Telephone & Telegraph Company has chosen a new board of directors, which elected D. K. Appenzeller, president; H. B. McNulty, secretary, and D. McLay, treasurer. Work on the line will be commenced this month.

DES MOINES, IOWA.— A new 2,000-drop switchboard has been contracted for by the Mutual Telephone Company, and is expected to be ready for use by the middle of September. It is one of the Stromberg-Carlson Company's latest type, and when completed will greatly improve the service.

BALTIMORE, MD.—The stockholders of the Interstate Telephone & Telegraph Company met in this city and elected the following directors: L. A. Carr, J. S. Carr and G. W. Watts, of Durham, N. C.; Dr. P. D. Fahrney and James E. Walter, of Frederick; Robert L. Carr and C. S. Watts, of Baltimore.

NEW ROCHELLE, N. Y.— The Phœnix Electric Telephone Company, of which George W. Sutton is president, has been given a franchise by the village trustees. The company agrees to give local service at $3 per month and to include free calls to any other system that may become part of the system.

ATLANTIC CITY, N. J.— The probabilities are that this city is about to have a competing telephone plant. The new company is to be known as the Atlantic Coast Telephone Company, of which E. L. Reinhold is president, and L. Kuehnle, treasurer. The rates will be about forty per cent less than are now charged.

CHATTANOOGA, TENN., will soon have an independent telephone exchange. Mr. J. A. Helvin some time ago secured a franchise, and is actively engaged in making preparations for the construction of the plant. The system will be first-class in every respect. In the center of

the city subways will be built, and no poles located in the center of the city. From 450 to 500 subscribers will likely be secured from the start.

LEBANON, PA.—The People's Telegraph & Telephone Company, recently organized in opposition to the Bell, has received part of its apparatus, and work can now be commenced. A large list of subscribers has been secured, and the number of patrons will reach over three hundred before the plant is started, which is expected to be October 1.

ATLANTIC CITY, N. J.—The Atlantic Coast Telephone Company, which was recently granted permission to run its wires in this city in opposition to the Bell Telephone Company, has completed its organization by electing the following officers: President, E. L. Reinhold; treasurer, Louis Kuehnle; directors—E. L. Reinhold, James B. Reilly, H. Burdcassel, H. L. Haldeman and Louis Kuehnle. The work of construction will begin shortly.

INDIANAPOLIS, IND.—There are good prospects that the telephone war will extend to the town of Irvington. The new telephone company is now at work in the suburb trying to secure subscribers preparatory to asking the town board for a franchise. The rate to be charged by this company will probably be in the neighborhood of $40 per year. It is said that nearly twenty subscribers have been secured in the brief time the company has been at work.

TRENTON, N. J.—The Home Telephone Company, of Trenton, has contracted with the American Electric Telephone Company, of Chicago, Illinois, for a complete outfit for their new exchange, No. 41 West State street. The contract specifies that the switchboards shall be delivered and ready to set up by August 10. When completed, which will be about August 25, the Home Company will have one of the finest equipped telephone exchanges in the State. The output consists of twelve mahogany switchboard cabinets, equipped with apparatus sufficient to connect twelve hundred subscribers immediately, and with space to accommodate two thousand.

INDIANAPOLIS, IND.—Work on the underground conduits of the new telephone company is being pushed rapidly. While the entire work in the mile square cannot be completed in three weeks, the work on the main streets can be, and after that the work will be in alleys and out-of-the-way streets. The company is placing twelve conduits in the trenches. These will easily serve 9,600 patrons, and in an emergency could be made to serve 12,000. It is supposed that it will be a long time before the capacity will be fully tested. For 9,600 'phones, 19,200 wires will have to be run in the conduits, as under the modern system that is to be used two wires are required for each instrument.

PERSONAL.

MR. I. J. KUSEL, who for the past two years has been connected with the American Electric Telephone Company, has joined the forces of the Victor Telephone Company, Chicago, and will hereafter look after the interests of Victor apparatus. The Victor Company is to be congratulated on securing the services of a gentleman whose wide and varied experience in the telephone field will no doubt do much in bringing the merits of Victor apparatus prominently before the public.

MR. EDGAR L. MILLER, formerly general manager of the Interstate Telephone & Telegraph Company, has resigned from that concern to accept a position with the Automatic Telephone Exchange Company, of Washington, D. C., and London, England. Probably few men are better and more widely known in the electrical field than Mr. Miller, his experience extending over a period of twenty-five years. He has been identified with the telephone business since the start of the Bell Company. He is now a member of the advisory board of the Association of Independent Telephone Companies of the United States. The Automatic Exchange Company is to be congratulated on securing the services of such a valuable man, and with his well-known push and energy he will undoubtedly meet with the fullest success.

TRADE NOTES.

FARR Telephone and Construction Supply Company has in press the sixth edition of its now very popular catalogue. New and improved instruments and other devices, coupled with a constantly increasing demand for this valuable handbook, make a new edition necessary, and all desirous of having the latest copy should send in their requests early.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY reports having just closed a contract with the Missouri Valley Telephone Company for the initial order covering the apparatus for the new exchange at Minneapolis. This will be one of the largest independent exchanges in the country, aggregating between five and six thousand lines when completed. The new Central Energy System will be used.

THE Victor Telephone Manufacturing Company, Chicago, announces that its improved bridging system does not and never has infringed the Carty patent. Users of Victor apparatus can rest assured that they are perfectly safe in the use of the company's instruments. Owing to the peculiar arrangement of Victor bridging apparatus, high-wound induction coils can be used, and line resistance overcome, insuring good results even over iron wire.

THE thirtieth edition of their popular book, "Steam," has just been issued by the Babcock & Wilcox Company, New York. This book has been for many years one of the standard works on water tube steam boilers, and on boiler practice generally. In the present edition much new and valuable matter has been added. It is beautifully printed, finely illustrated, and bound in a substantial manner. Anyone interested in any way in the generation of steam will receive a free copy upon request.

IN a neatly printed and elaborately illustrated pamphlet the Automatic Telephone Exchange Company (Limited) gives a comprehensive description of its new automatic exchange system, which, it is claimed, is destined to supersede the present method of telephone service. While crude suggestions in this direction were made several years ago, the development into a perfect working system capable of answering every public demand has required a concentration of inventive talent and business energy, with expenditure of money so great as to be almost beyond belief. In the Automatic Exchange system, all the defects of earlier forms of apparatus of this kind seem to have been overcome in a satisfactory manner. The Automatic Telephone Exchange Company (Limited), of Washington, D. C., and London, England, will gladly give further particulars in regard to the details of its apparatus.

INDEPENDENT telephone companies evidently believe that any apparatus good enough for the Bell Company is good enough for them, especially if it has been perfected in that company's use. As a result of such belief, the Sterling Electric Company, Chicago, during the past few weeks entered the following orders: The Mutual Telephone Company, of Des Moines, Iowa, 2,000 drops standard metallic circuit board; La Fayette Harrison Telephone Company, of La Fayette, Indiana, the equipment complete for a 1,000-drop exchange, consisting of switchboards, cable terminals and protectors, and distributing boards; the Plymouth Telephone Company, of Plymouth, Indiana, 200 drops metallic circuit board; the Schance and Fair Electric Company, of Chrisman, Illinois, 100 drops of standard metallic circuit board. This apparatus, when installed, will give the independent companies the same central office equipment as the Bell Company is using, which is a guarantee in itself of as good service as can be furnished.

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Electric Railways — Preliminary survey, railway generators and motors, cars and equipment, line construction, speed regulation, rapid and long distance service.

Electric Heating — Methods and advantages, electric furnaces and applications to electro-chemistry, electric welding.

Alternating Currents — Principles, phenomena and applications, transformers.

Electric Power Transmission — Transmission by continuous and alternating currents, polyphase systems, synchronous and asynchronous motors, calculation of the line, commercial aspects.

Central Station Engineering — Design of plant, selection of system and apparatus for most economical working, management, testing.

Telegraphy and Telephony — Principles, systems, apparatus, operation.

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Machine Parts — Engineering material, rivets, screws, couplings, bearings, shafts, pulleys, gearing, valves, pistons, connecting rods, engine frames, etc.

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he has solved the problems accompanying the first paper, he returns them and takes up the study of the second paper. If the solutions are of such a character as to indicate the student's familiarity with the subject, the next following paper is sent. In this manner he always has a paper at hand to study. If he is capable he will receive four papers a month for his two dollars. All questions asked outside of the sheet of problems (which will be returned postage free with the next paper if the solutions warrant it) must contain a stamp for return answer. Everything will be explained so fully in the instruction sheets that it will rarely be necessary to ask additional questions. On subjects the nature of which is such that written instructions only cannot convey a satisfactory understanding to the student, personal explanation will be given, if desired.

Endeavoring to make the student a thorough master of the course pursued by him, so as to obviate the possibility of his acquiring incorrect or incomplete ideas, which are always dangerous, we hold ourselves personally accessible to all of our students, who are urged to call upon us to clear away any difficulties that may arise and which cannot otherwise be removed.

Students familiar with algebra, geometry and trigonometry may start with analytics and calculus. Instruction may be interrupted for one month or more without charge during that time.

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CHAUNCEY G. HELLICK, C. E., M. S., Ph. D.,

Associate Member American Institute of Electrical Engineers.
For five years in charge of the Department of Electrical Engineering at Lafayette College, Easton, Pa.

AND **FRANZ J. DOMMERQUE, M. E.,**

Life Member Academical Society of Mechanical Engineers, Munich, Bavaria.
Member American Institute of Electrical Engineers.
Member International Association for Promoting the Study of Quaternions and Allied Systems of Mathematics.
Graduated in 1883 from Mathematical Institute, Zurich, Switzerland, and in 1887 from Technical University, Munich, Bavaria.
Electrical and Mechanical Engineering practice for the past eleven years.

Address FRANZ J. DOMMERQUE,

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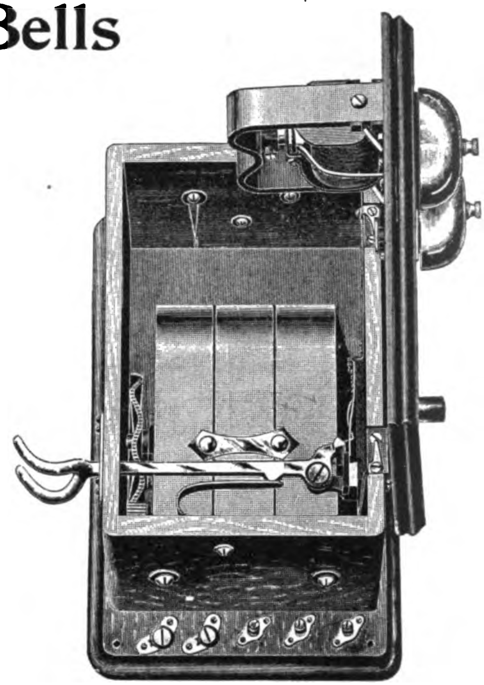

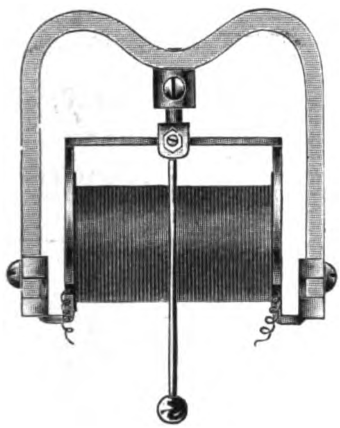

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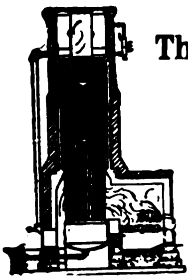

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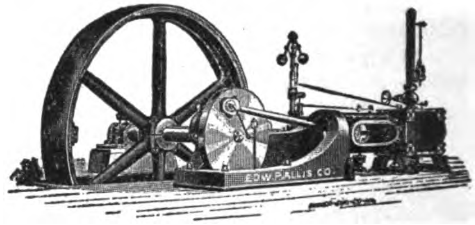

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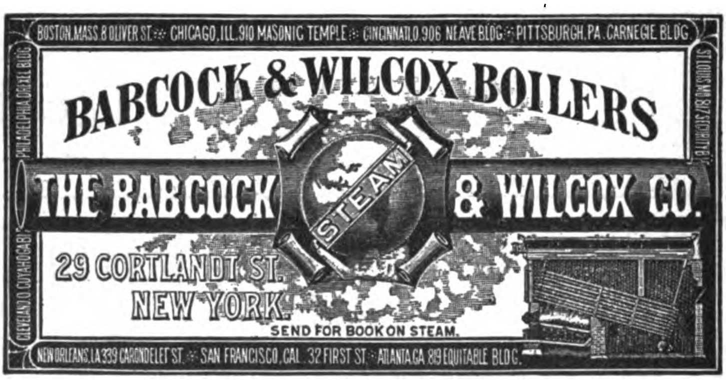

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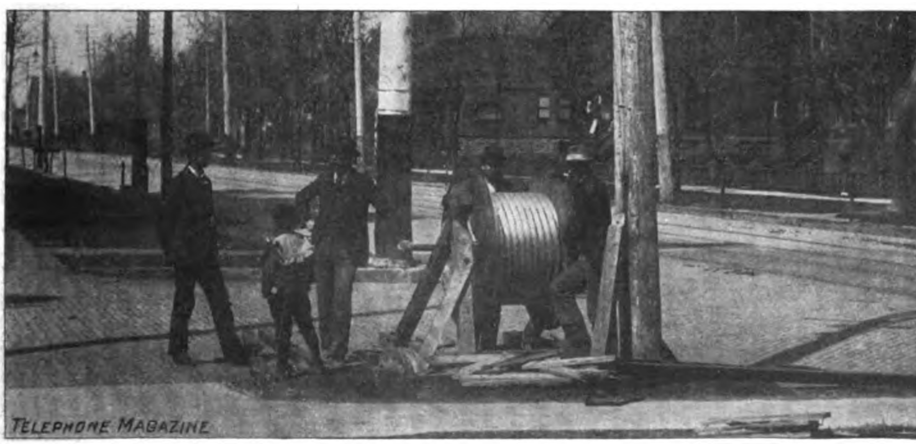
VOL. XII. CHICAGO, SEPTEMBER, 1898. No. 84.

THE EXCHANGES OF THE VALLEY TELEPHONE COMPANY, SAGINAW, MICHIGAN.

INTRODUCTION.

It was in June, 1896, when the business men of the Saginaw Valley, believing that the rates charged them for telephone service were excessive, asked the Michigan (Bell) Telephone Company to reduce its rates. The answer of the Bell people was that *it was impossible to do so* because the earnings of the Saginaw Valley would not justify such action on their part. At that time one of the arguments used by the business men was that in other cities competing companies were starting up, and that there would be one in the Valley *unless the rates were lowered.* As a result of the refusal of the Michigan (Bell) Telephone Company to give reasonable rates, an independent local company was organized called "The Valley Telephone Company."

On April 27, 1897, the present company was formed and incorporated, purchasing from the previous organization some franchises as well as some work that had been done in the way of securing subscribers. John L. Jackson was elected president; S. G. Higgins, secretary; and W. H. Gilbert, managing director, these three residing in Saginaw; while James E. Davidson, vice-president, Orrin Bump, treasurer, and E. A. Cooley, all of Bay City, made up the board of six directors. These three gentlemen still retain their positions as



VALLEY TELEPHONE COMPANY.—LAYING STANDARD UNDERGROUND CABLE.

officers and directors. Mr. W. H. Gilbert soon after retired as managing director on account of his time being required by other business interests, while Mr. Jackson was obliged to resign from the presidency in December, 1897, owing to ill health. He was succeeded by Mr. Higgins, who retired in May following for the same reason, and was succeeded by Mr. F. W. Carlisle, the present incumbent. Messrs. W. C. Phipps and E. C. Ewen were added to the number of Saginaw directors. At the time Mr. Higgins succeeded Mr. Jackson as president, the board appointed Mr. R. F. Johnson, one of Saginaw's most prominent citizens, as secretary and general manager, and it is undoubtedly due to his wide business experience, untiring energy and good management that in a little over a year the magnificent system of exchanges was brought to completion and placed in successful operation, giving today a service to its patrons which, in points of efficiency, comparative cheapness and high quality in general is not excelled by any independent exchange in the country.

The preliminary details having been completed, the company was met with the perplexing problem of selecting suitable exchange apparatus, buying the necessary construction material and proceeding with the equipment of exchanges and building of lines. The company soon realized that the safest and most economical way would be to employ a constructing engineer of undoubted ability and integrity, under whose direction and superintendence the entire plant was to be installed.

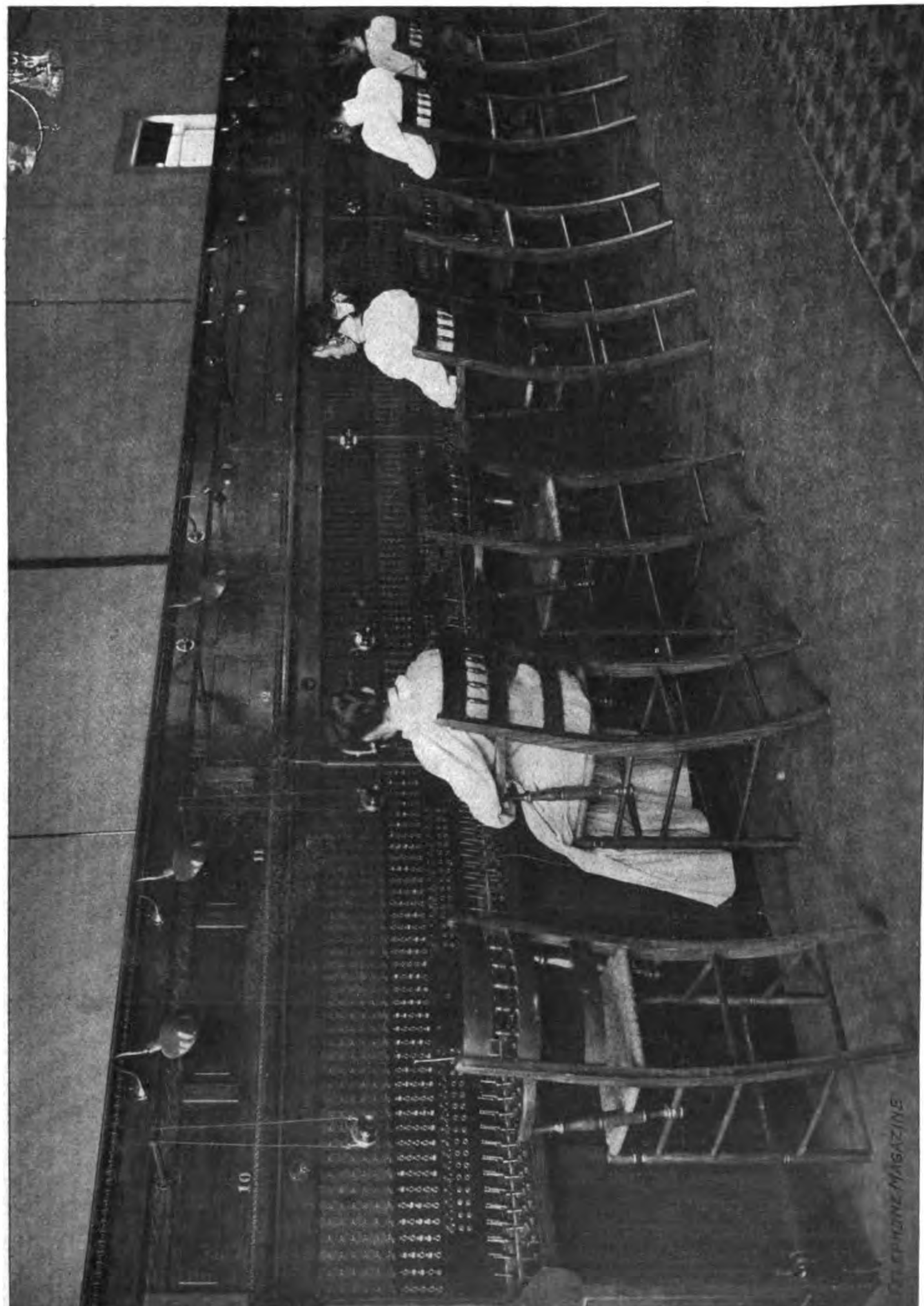
Mr. F. R. Marsh was selected for that position, and entered upon his duties on July 1, 1897. A month or two were consumed in making the necessary plans, estimates and specifications, from the large switchboard down to the most minute details, after which actual work was commenced, proceeding uninterruptedly until last month, when the Bay City and Saginaw exchanges were successfully opened for public service.

THE EXCHANGES.

The system of the Valley Telephone Company comprises five exchanges — one at Saginaw, with a sub-exchange on the West Side; another at Bay City, with a sub-exchange in West Bay City, and one at Flint, having a capacity for 300 subscribers in that town. In the Saginaw exchanges provision has been made to eventually accommodate 1,600 lines, while at Bay City the number can be increased to 1,200, making an ultimate capacity of over 3,000 lines for the five exchanges. The territory covered contains some 120,000 people, who directly or indirectly can obtain telephonic communication with each other.

The Saginaw main exchange is located on the second floor of the Ely building, a substantial six-story structure on the corner of Germania street and Washington avenue, in the very heart of the business district. Here are also the general offices of the company. A large, well-lighted and ventilated room is used as the exchange proper. Comfortable quarters have been provided for the general manager's office, accounting department, stock room, battery room, as well as a comfortable dressing room for the operators. The exchange equipment at present consists of an 800 metallic line Sterling switchboard, furnished by the Sterling Electric Company, Chicago. The board is of the company's well-known regular, sectional type, with the Beach-Cook transfer system arranged beneath the jacks. The board, consisting of four 200-line sections, is placed along one side of the room, sufficient space being on the opposite side to allow for the addition of a duplicate, should the number of subscribers require it. In the meantime, additional sections can be added from time to time as required. This is a feature adopted by the Sterling Company from the start, possessing many advantages over boards of a definite capacity, which, in case of a desired extension, will either have to be duplicated or exchanged for larger ones. The board is a duplicate of the one at Bay City, shown in our illustration.

At the rear of the operating room is placed a row of eight combined terminal and protector boards, of which a good view is shown in Fig. 1. Here also provision is made for any future additions, by allowing space for another row



VALLEY TELEPHONE COMPANY.—800-LINE STERLING SWITCHBOARD IN BAY CITY EXCHANGE.

back of the present one. Each of the protectors is made of an iron casting, on the inside of which are arranged two rows of double binding posts, or connectors, the back row of posts receiving the cable ends, while the front row leads to the distributing board.

On the West Side a sub-exchange is located, equipped at present with a 200-line Sterling board of the same type as used in Saginaw and in Bay City.

tained, and does not depend upon any auxiliary connections for rapid service. It has a number of special features, which generally cause it to be selected in the equipment of exchanges where efficiency and high quality in general is desired.

THE UNDERGROUND WORK.

As already stated, the Ely building, where the exchange is located, is in the busiest and most crowded part of the

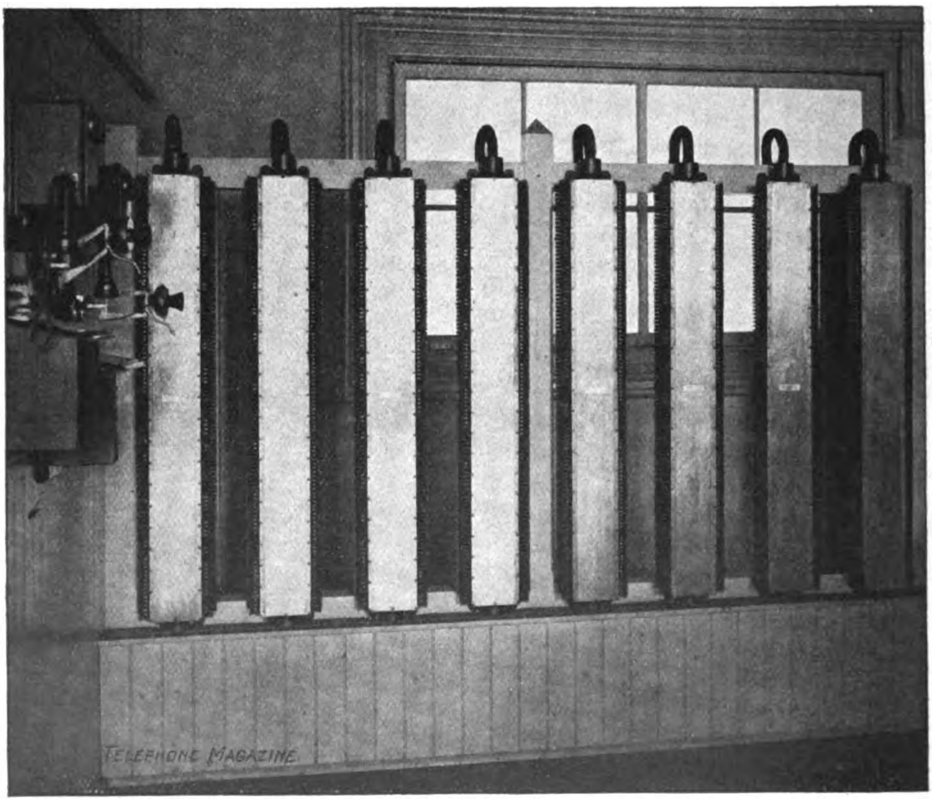


FIG. 1.—Sterling Terminal Boards.

In the West Bay City and in the Flint exchanges, the switchboards used are of the American Electric Telephone Company's new "Express" type, the Flint board having a capacity at present of three hundred subscribers, while in West Bay City two 100-line sections are so far connected. This type of board, of which a 100-drop section is shown in Fig. 2, is, no doubt, the most rapid switching device that is entirely self-con-

city. How to reach the premises with the 1,500, or possibly 2,000, pair of conductors through the network of wires and cables belonging to the existing concerns, such as the Bell, Western Union, Electric Light and Street Railway Companies, was a problem that seemed not easy of solution. Of course, heavy 60 or 70 foot poles, reaching over anything on the streets, could have been placed; but even by cabling the wires,

the result would have been unsightly, impractical, and in the end unstable. It was, therefore, decided to place conduits along the most crowded streets, and thereby avoid all overhead interference and disturbances. This was done in both Saginaw and Bay City, the style of conduit selected being the creosoted wood tubing made by the Michigan Pipe Company. This is probably the simplest and at the same time thoroughly reliable form of conduit in use. It is made in lengths of 8 feet, in sizes of from 3 by 3 inches with a 1½-inch hole, to 4½ by 4½ inches with a 3-inch bore. The latter size is used throughout the Valley Company's plants. All the holes are finished with a reamer, making a smooth, continuous opening, allowing the cables to be drawn through without being caught upon offsets or projections.

The joints are accurately centered so that there is no "lip" formed to offer obstruction.

The laying of this conduit is one of the most simple operations. No foundation of concrete is required. A creosoted board or plank is first laid in the bottom of the trench for a foundation, and another creosoted board laid on top of the conduits to protect them from the blows of picks and bars in the hands of workmen making excavations for other purposes in after years.

By the use of short pieces curves can be formed either in alignment or grades, without extra cost for specials for such places.

Our illustration, Fig. 3, shows a four-duct three-inch line of conduit ready to be covered up. Fig. 4 shows the manhole construction. This particular view was taken just at the entrance to the Saginaw main exchange, the cables being led from the manhole through a cemented tunnel 5 by 6 feet to the basement of the building, and from there through paraffin cables of 100 pairs each, direct to the cable terminals illustrated in Fig. 1;

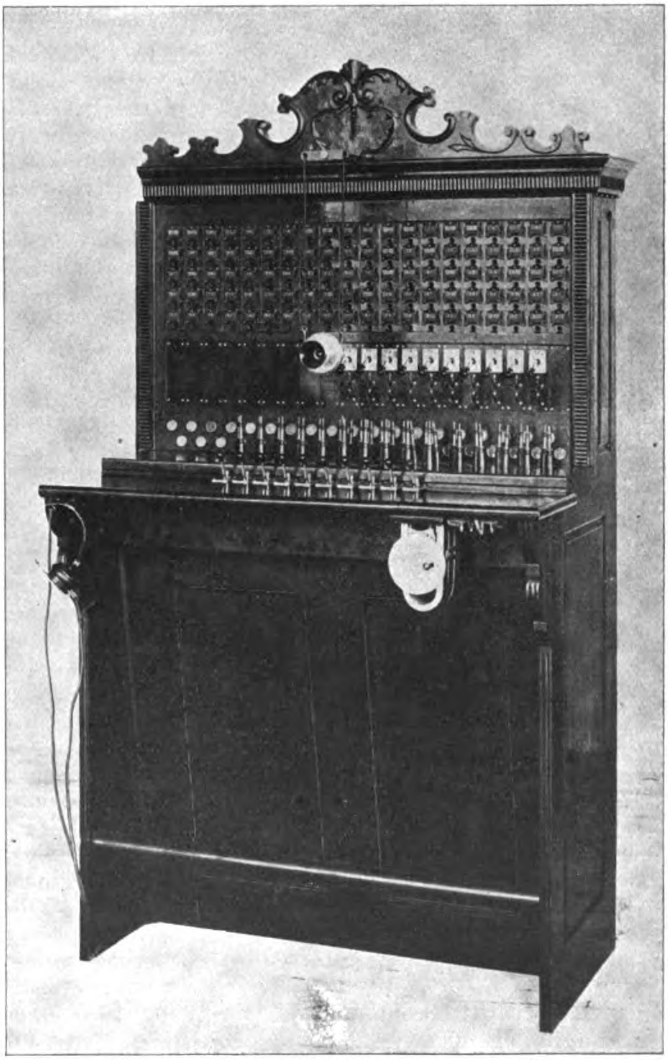


FIG. 2.— 100-Line Section American Express Board.

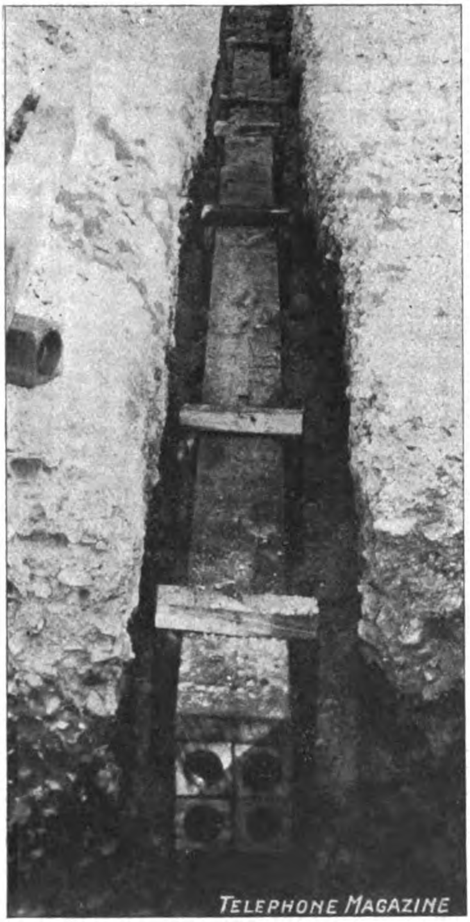


FIG. 3.—Four-Duct Conduit.

4,500 feet of this cable was used around the Saginaw and Bay City offices. The amount of conduit required in bringing the cables to both exchanges was 88,000 feet, or nearly seventeen miles.

CABLES.

The cables used throughout the construction of the plant—aërial, underground and submarine—were furnished by the Standard Underground Cable Company, and are of that company's well-known dry core paper insulated type. For the conduits the following sizes and amounts were required:

2,147 feet 10-pair Standard lead-covered
4,411 " 25 " " " "
5,249 " 50 " " " "
2,226 feet 75-pair Standard lead-covered
31,361 " 100 " " " "

For cabling on poles along the crowded parts of the line, the two sizes of 25 and 50-pair standard cable were adopted, 19,790 feet of the former being used and 26,667 feet of the 50-pair.

LINE CONSTRUCTION.

In the pole-line work and overhead construction in general, can be seen one of the best examples of modern high-grade engineering practice. In the selection of the necessary material, such as poles, cross-arms, insulators, wires and cables, quality was the first consideration, and combining with it the best of labor and intelligent supervision, the result is a system of line construction, that in uniformity, durability and high quality is not surpassed by any other plant of the kind.

Looking along Court street, from the terminal pole west (Fig. 5), the observer cannot help but be favorably impressed by the Valley Company's lead of straight substantial 50-foot poles, nicely painted in white and black and carrying some fifty circuits above all obstructions, as compared with the old company's handful of rusty wires, struggling for existence among the swaying branches of the trees.

In the illustration, Fig. 6, is seen another example of beautiful line construction, the view showing a lead of 50-foot poles running south on South Park avenue. The poles carry eight 10-pin cross-arms, the terminal pole in the foreground, from where the cabled lines are led to the manhole located at the street intersection, being double cross-armed and equipped with the now well-known Sterling pole top terminals. This terminal is made up in sizes of 25 to 100 pairs of wires, is of solid iron in three parts and circular in form. It is placed directly upon the top of the pole, which has first been sawed square. The cable is brought into the terminal from the bottom, the lead cover being stripped back and the wires spread to connecting points. These connections appear upon the inside of the terminal through hard-rubber bushings and correspondingly upon the outside of the terminal. The

bushing is secured through the terminal in a permanent and air-tight manner, the connections through the bushings being numbered consecutively upon the bottom piece of the iron casting. From the outside connection upon the rubber bushing a spider wire is carried to the line wire upon the cable pole. The cable in the terminal, where it comes into the same, is soldered in place. A rubber gasket is used to make an air-tight joint between the body casting and the lid casting of the terminal. Outside and over all of this is a one-piece copper cover which fits down closely over the entire terminal, being held into place by the rubber gasket, making it absolutely safe from any weather.

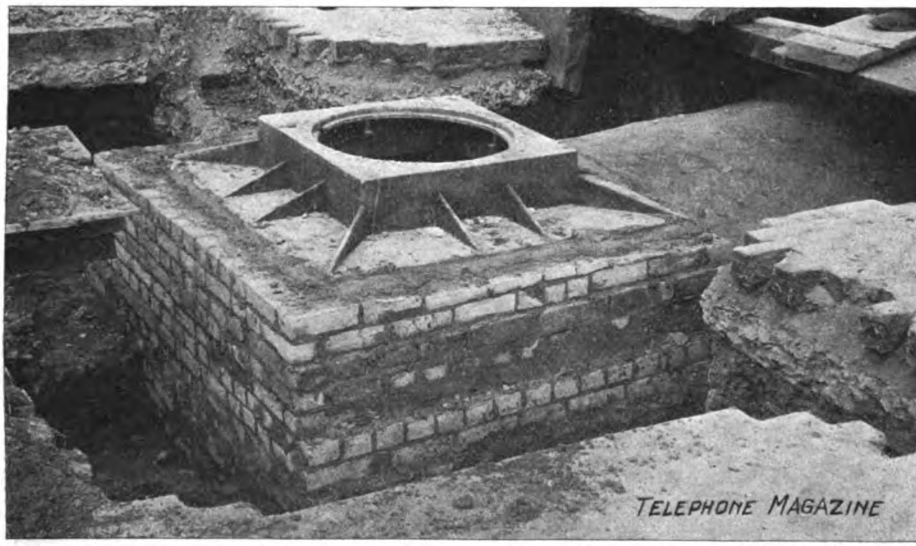


FIG. 4.—Subway Construction.

Before sealing either the terminal and protector or the pole-top terminal, there is placed within the case four or five pounds of quicklime, which absorbs every particle of moisture within the terminal.

The neatness and compactness of this style terminal, as compared with the old-fashioned cable box, platform and railing, must be apparent to even the most casual observer.

The amount of line material used in the construction of the overhead circuits is as follows:

Poles.............	1,674	25-foot, 6-inch top
	890	30 " 6 " "
	412	30 " 7 " "
	333	35 " 7 " "
	708	40 " 7 " "
	507	45 " 7 " "
	371	50 " 7 " "
Cross-arms.......	12,000	10-pin
	1,800	8 "
Pins and Brackets.	40,000	1¼-inch split locust
	22,000	1¼ " oak
	9,600	Oliver steel
	8,000	pole brackets, oak
Insulators.......	114,000	Pony, regular
	12,000	transposition

The insulators, as well as a large quantity of the smaller construction material, were furnished by the Central Electric Company, Chicago, whose proverbial promptness in filling orders did much in aiding the uninterrupted completion of the plants.

Probably no exchange was ever built in which the Okonite products were not used to some extent. In this case the amount of duplex Okonite wire, used for inside wiring, switchboard work, etc., amounted to some 122,000 feet, or a little over twenty-three miles, while of single Okonite and rubber-covered wire for smaller incidental connections 2,500 feet were required. This also came through the Okonite Company's general

Western agents, the Central Electric Company.

For the construction of the circuits proper, No. 14 galvanized steel wire was adopted, 1,570 miles being required, and about 110 miles of No. 14 B. B. galvanized iron being used in addition. The exchanges at Bay City and Saginaw are connected by 15 metallic trunk lines, built of No. 12 galvanized E. B. B. wire; the distance between the two cities along the pole line is about seventeen miles, and it took 527 miles of wire for the circuits.

As can be seen from the several illustrations, the guying of all terminal and corner poles is done in a most substantial and efficient manner, all strains being relieved by guys, varying in strength from that of No. 8 3-wire stranded 3-ply galvanized steel cable, of which 12 miles was used, to the plain No. 8 steel guy wire, which, if connected end to end, would furnish enough wire for a 26-mile circuit. All of the steel and iron wire used came from the mills of the Washburn & Moen Company.

For the equipment of the subscribers' stations throughout the entire system, including the transmitting and other accessory devices in all exchanges, the apparatus of the American Electric Telephone Company, of Chicago, was adopted after a thorough test of a number of instruments submitted by other manufacturers. The No. 37 long-distance type (Fig. 8) was selected for the regular subscribers' stations, while the new

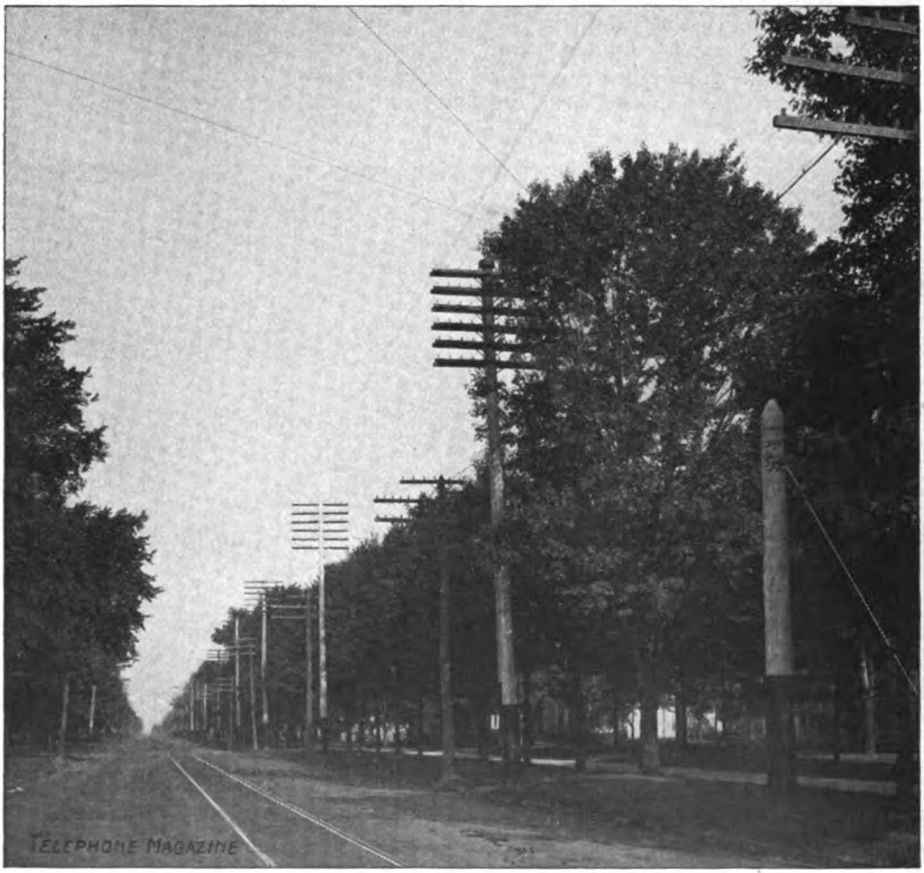


FIG. 5.—Looking Along Court Street.

No. 40 desk set, shown in Fig. 9, is furnished for offices, or wherever a more convenient type than the wall set is desired. The many good qualities of these instruments are so well known that any detailed description of them would seem superfluous. In all of the American devices a combination of the best workmanship and high-grade material, combined under the direction of experienced designers and engineers, long ago secured for American apparatus the high plane it occupies today.

The Burns patented double-pole receiver, furnished with all the instruments, deserves especial mention, its construction being clearly seen in Fig. 10, showing the receiver with the shell removed. It is probably the most perfect and reliable receiver on the market today, its sensitiveness, loud-talking qualities, positiveness and ease of adjustment and accessibility of all parts making a combination of good qualities not found in other instruments of the kind.

EXCHANGE ACCESSORIES.

In the equipment of the signaling devices in the exchanges, as well as in the provisions made for furnishing current to the switchboard transmitters, the most modern engineering practice has again been followed, as in all other parts of the plants. In each exchange a handsome marble switchboard, substantially mounted in an iron frame, contains the necessary switches for making any desired combination between the several circuits and generators. The latter consist in each exchange of a Holtzer-Cabot motor-generator, being driven from a 500-volt city power circuit and delivering an 80-volt alternating current through

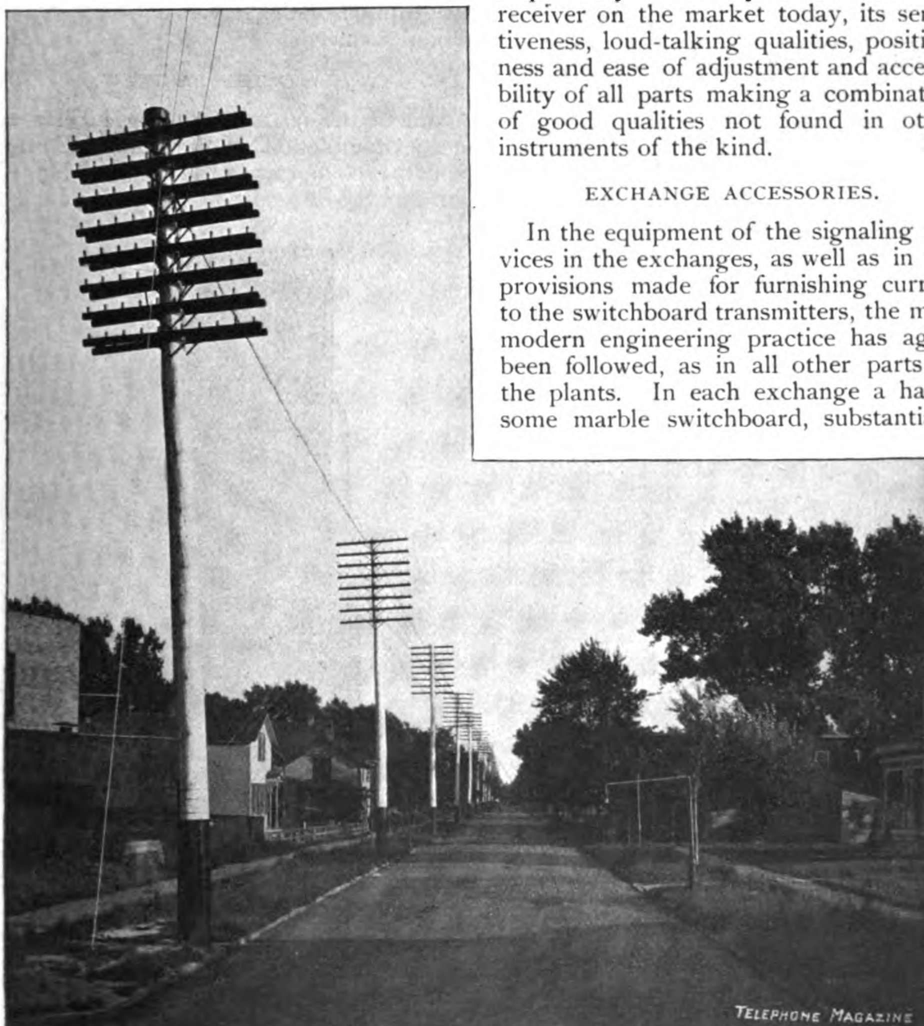


FIG. 6.—Lead on South Park Avenue.

the switches to any of the operators' calling sections. A second motor-generator transforms the 500-volt current into one of six volts, which at a normal rate of 35 amperes, charges a set of four American storage cells, type N 6, of 200

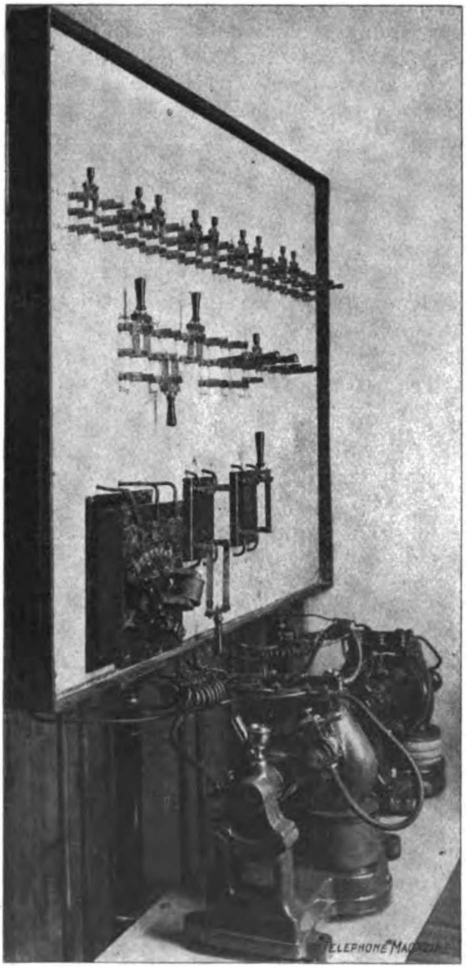


FIG. 7.—Switchboard.

ampere hour capacity each. These cells are arranged in multiples of two, giving a normal rate of discharge of 60 amperes, at a pressure of 4 volts. The illustration gives a view of the arrangement of switchboard and generators in the Bay City exchange, the one at Saginaw being a duplicate of this one. Either set can be used for serving either or both exchanges, but in case of the most improbable accidents causing both to be disabled at the same time, the Bay City exchange is provided with a third or reserve set, operated by a water motor from the city mains, so that complete interruption of the service is made next to impossible.

CROSSING THE SAGINAW.

One of the most interesting incidents in the completion of the Valley Company's exchanges was the laying of a 75-pair No. 8 iron armored submarine cable

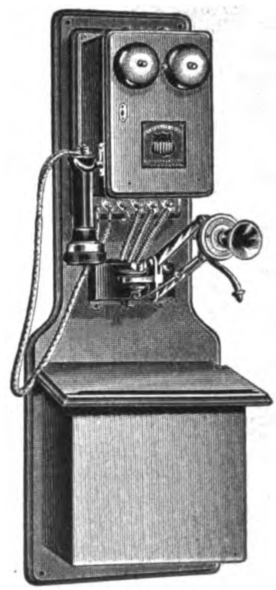


FIG. 8.

across the Saginaw river, between the east and west sides of Saginaw City. At the foot of Johnson street, where the crossing was made, the river is about 1,000 feet wide, necessitating a continuous piece of cable 1,050 feet long. This was made specially by the Standard Underground Cable Company, and was laid in January last, when the river was covered with a solid sheet of ice. The illustration shows the work partially completed. The cable on its reel, having been securely located on one of the shores, a trench some four inches wide was chopped in the ice, leaving a sufficient thickness at the bottom of the trench to support the cable while being

drawn across by four stout men, the work being successfully done under the direction of Superintendent F. R. Marsh. The ends of the cable having been suitably secured at each shore, the bottom of the trench was cut through and the cable allowed to sink gently to the bottom of the Saginaw, where it now lies, transmitting intelligence between thousands of people. In addition to this cable, some 2,500 feet of 50-pair No. 8 iron armored Standard Underground was laid in other places, where submarine cables were found to be required.

FIG. 9.

Much of the remarkable success met with by the Valley Telephone Company in the building, completion and profitable operation of its plant is undoubtedly due to the liberal and broad-gauged policy adopted toward its patrons from the start. As can be readily imagined, the Bell Company, following its usual line of action in cases of this kind, no sooner found itself confronted with the choice of having either to reduce the exorbitant rates it had been charging for years or to withdraw from the field, began a system of warfare by offering telephone service at rates which it openly claimed were only "war rates" and would not hold after the impending competition had been crushed.

The rates charged by the Bell Company up to this time had been $30 for residence 'phones, $42 for business houses and $72 for long-distance service, prices under which the earnings of the Saginaw Valley did not justify a reduction in rates, according to a reply made to the citizens' request for cheaper

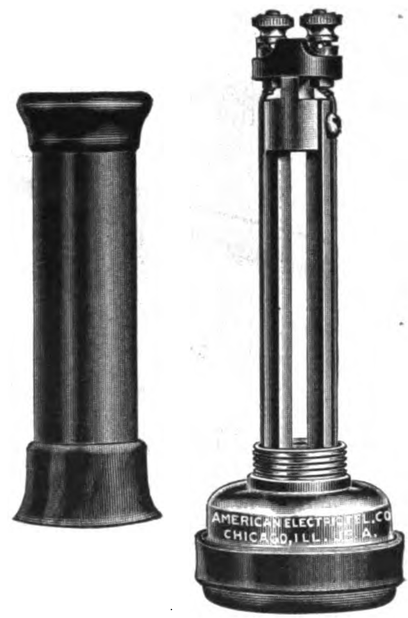


FIG. 10.— Burns Double-Pole Receiver.

and better service. At the "war rates" of $12, $24 and $46, respectively, the Bell Company succeeded in adding a hundred or two names to its fast dwindling list of subscribers, while the Valley Company quietly secured its necessary one thousand subscribers at its established rate of $20 for residence and $30 for business service.

Although the contract made by the Valley Company with its subscribers gives the company the right to charge for service as soon as one thousand lines were connected, and this point was reached on August 18 last, the company extended the time to October 1 following, by which time some fifteen hundred satisfied subscribers will be served from the most modern and efficient system of exchanges in this or any other country.

To Manager R. F. Johnson and his able staff of assistants the TELEPHONE MAGAZINE extends its best thanks for their assistance in the preparation of this article.

INDEPENDENT TOLL LINE RATES IN IOWA.

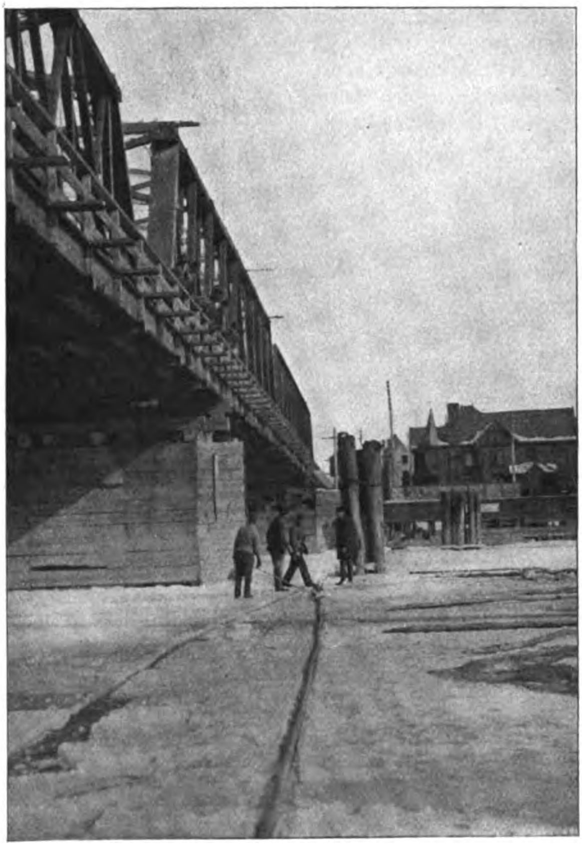
The Iowa Association of Independent Toll Line Telephone Companies at its meeting, held in Des Moines last month, adopted the following schedule of rates for a single message:

	Cents.
20 miles or under	.20
20 to 30 miles	.25
30 to 40 miles	.30
40 to 45 miles	.35
45 to 50 miles	.40
50 to 60 miles	.45
60 to 75 miles	.50

Above 75 miles, five-eighths of 1 cent per mile.

The above replaces the schedule of rates according to counties through which messages passed.

The old percentage of division of receipts was retained. It provides that where a message goes over two lines the originating line gets 60 per cent of the receipts and the other company 40; in case of three companies, the originating line gets 50 per cent and the other two 25 each, and in case of four companies, the originating company gets 40 per cent and the other three 20 each.



CROSSING THE SAGINAW.

TELEPHONES IN COSTA RICA.—There is a notice on the wall of a telephone exchange in Costa Rica requesting the lady operators to "abstain from smoking" while on duty.

ANOTHER order for a 400-line equipment, Central Energy System, for Ashland, Wisconsin, has just been secured by the Stromberg-Carlson Telephone Co.

THE ALGEBRA OF ELECTRICITY.

BY CHAUNCEY G. HELLICK.

Anything that permits of a change by increase or decrease is called a quantity. The process of expressing a quantity by numbers and manipulating the same by aid of other numbers is termed algebra. Sometimes the number is represented by a letter of the alphabet, which is done for the purpose of making a general statement or giving a general solution of a problem. It is customary to choose the first letters of the alphabet for known values and the last letters, beginning with x (and if x, y and z do not suffice, to go back to w, v, u, etc.) for unknown values. Thus a, b, c, etc., means that we know numbers whose values are represented by a, b, c, and could write them down, but do not care at the present instance to do so, while x means that we do not know the number to express the quantity by, but are endeavoring to find it. It is the purpose of algebra to find values for x, i. e., to express something we do not know in the terms of a thing or things we do know. But the known things by which we attempt to express the unknown must be of the same kind; that means must be based upon the same unit as the unknown thing. We cannot combine gallons with inches, else we could measure milk by the yard. The units used in electrical measurements must be familiar to the student before he can apply algebra to electricity; they must be absolutely fixed in his mind, and it is just in this direction where most mistakes in calculations are made.

Continental European physicists, when studying the theory of electricity, saw the necessity and simultaneously the possibility of creating a unit by which all physical quantities could be expressed. Gauss and Weber became the originators of the so-called system of "absolute units," which is the standard of today. They observed that by nature's law the *motion* of a body or a *mass* varies with the *time*. The measurement of motion reduces to the measurement of length, and thus there are three operations to be performed, namely, measuring length, mass and time, each of which is entirely independent of the others and irreducable. As unit of length the centimeter was adopted, which is the hundredth part of a meter, for the length of which the ten-millionth part of a quadrant of a meridian was selected. Afterward it was found that this ten-millionth part had not been measured accurately, and thus our present meter is not absolutely what it was intended to be. The original meter (the name is borrowed from the Greek μέτρον, measure) is kept in Paris as a standard of comparison.

As unit of *mass* the gram was chosen, one gram being the weight of one cubic centimeter of water at a temperature of 4° Cent.

The unit of *time* is the second, being the 86,400th part of an average solar day. The system embodying these three units is called and written shortly the "C. G. S. System."

Knowing now the three fundamental units, length, mass and time, we may derive units for any other physical quantity. From length we deduce area. The unit of length is one centimeter (abbreviated 1 cm). The unit of area is the square centimeter (abbreviated sq cm or cm^2, the latter being mostly used by men of science to whom the C. G. S. system is an everyday convenience, and in these pages we will use this abbreviation also). An area is bounded by a number of sides which may be straight lines or curves. It is difficult in some cases to measure the area exactly (that is to say calculate it,

for it is easily *measured* by a planimeter) when the boundaries are not straight lines, but the cases we will have to deal with are mostly such where the sides are not only straight lines, but also are at right angles to each other, hence it is an easy matter to find the area if the sides are all of equal length and at right angles to each other: measure one side by the unit 1 cm (it is advisable, nay, necessary, to become familiar with the metric system, and, therefore, we shall use it here persistently) and multiply the resulting number by itself, or what amounts to the same, form the second power of the length of one side, the result being the cm^2 contained in the area. If the two adjacent sides are not equal, but opposite sides are equal and all sides are at right angles to each other, measure the two adjacent sides by the cm and multiply the obtained numbers by each other.

Example: To find the area of a rectangular room 8 by 10 feet.

First transform feet into cm; 1 foot = 30.479 cm and 1 inch = 2.53995 cm (for convenience it is near enough to remember that 1 foot = 30.5 cm and 1 inch = 2.5 cm); then 10 feet = 304.97 cm and 8 feet = $30.479 \times 8 = 243.832$ cm; hence, area = $304.97 \times 243.832 = 74{,}317$ cm^2, leaving off the decimals.

From the unit of length we derive the unit of *volume* by forming a cube having for its six sides the cm^2; this cube we denominate the cubic centimeter, and write it cm^3. The volume of a body is easily found if the sides are squares or rectangles, and at right angles to each other, but if the body has an irregular shape the determination of its volume is very difficult, and must be left to mathematics.

Example: 1 cubic foot = $30.5 \times 30.5 \times 30.5 = 30.5^3$ (30.5 in the third power) = 28372.623 cm^3.

1 cubic inch = $2.5 \times 2.5 \times 2.5 = 2.5^3 = 15.625$ cm^3.

Of weight not much needs to be said; we may mention that 1 pound = 453.59 grams (450 gr is easier to remember). 1 kilogram is used in everyday commerce in the countries using the metric system; 1 kilogram, abbreviated 1 kg $= 1000 \text{ gr} = \frac{1000}{453.59} = 2.2046$ pounds (remember 1 kg = 2.2 pounds).

Less need be said of time.

In the C. G. S. system we symbolize length by C, mass by G and time by S; in accordance therewith we symbolize area by C^2 and volume by C^3, C, C^2 and C^3 being termed "the dimensions." Now, taking time also into consideration, we can obtain the unit of *velocity*, which is that unit in which the distance of 1 cm is reached in 1 second.

Example: A horse covers 1 mile in 3 minutes; its velocity is then ⅓ per minute, or reduced to the C. G. S. system, $\frac{5280 \times 30.479}{3 \times 60} = \frac{160929}{180} = 894$ cm per second.

From this example we draw the conclusion that velocity is a ratio (in the above case $1 \div 3$) of length or distance to time, thus the dimension: velocity = $\frac{C}{S}$ which is mostly written CS^{-1} (mathematical explanation: $\frac{C}{S} = \frac{C \times S}{S^2} = C \times \frac{S}{S^2} = C \times S^{1-2} = CS^{-1}$)

The rate at which velocity increases with increasing time is called acceleration. The unit of *acceleration* is that unit by which the unit of velocity increases during unit of time.

Example: A train travels a mile a minute, or $\frac{160930}{60} = 2682$ cm per second. Had it traveled the second before only 2600 cm per second, it would have increased its velocity by 82 cm, and this

would have been its acceleration. The dimension of acceleration is $\frac{\text{velocity}}{\text{time}} =$
$\frac{CS^{-1}}{S} = CS^{-1-1} = CS^{-2}$

To give a body or mass acceleration, force is required. In mechanics force is defined as the product of mass into acceleration. The unit of *force* is that unit which gives to a mass of 1 gram in 1 second an increase of velocity equal to the unit of velocity. This unit of force was honored with a special name, the dyne (from the Greek δύναμις = force). All our weights are forces, for the weights indicate the force by which gravity acts upon the mass. Gravity imparts to the mass a velocity of 981 cm in the unit of time; hence, weight of 1 gr = 981 dynes. In physics 9.81 (which is 9.81 m per second) is denominated by the letter *G*. Dimension of force $= G\frac{C}{S^2} = CGS^{-2}$

A body or mass thus acted upon by a force is able to do work, which can be measured by the product of force into distance. Thus the unit of *work* is that unit which aggregates 1 dyne in moving the mass 1 gram through a distance of 1 cm. This unit received the name "erg" (from the Greek ἔργον = work).

Example: 1 foot pound per second = $30.5 \times 453.59 \times 981 = 13{,}571{,}600$ ergs
1 meter kilogram $= 100 \times 1{,}000 \times 981 = 98{,}100{,}000$ ergs (practically, 1 mkg = 100,000,000 ergs). Dimension of unit of work $= CG\frac{C}{S^2} = C^2GS^{-2}$

Taking the time in which work is done into consideration, we arrive at power. The unit of *power* is the unit of work done in unit time, which can be expressed briefly by erg per second. Power must not be confounded with energy, as it is not energy but the equivalent of energy transmitted from one body to the other. In engineering, the unit of power or the erg is not often used, being too small a unit; mechanical engineers measure the effect of force or the rate of work by the horse-power (HP), the English and American engineers fixing the HP at 33,000 foot pounds per minute, or 550 foot pounds per second, i. e., they say that it is the equivalent of 1 HP to lift 33,000 pounds 1 foot high in a minute. The continental engineers use the value 1 HP = 4,500 meterkilograms per minute, or 75 mkg per second. Electrical engineers use the "kilowatt" instead of the HP, 1 watt being ten million times 1 erg per second. Thus 1 HP $= 9.81 \times 75 = 735.75$, or in round numbers, 736 watts or also .736 kilowatts. In our country we put 1 HP = 746 watts. The reason for this difference lies in the fact that our engineers derived their value from the foot pound. As shown in the previous example, 1 foot pound per second = 13,571,600 ergs, which can now be expressed in watts by dividing by 10,000,000; hence 1 foot pound $= \frac{13{,}571{,}600}{10{,}000{,}000} = 1.35716$ watts, and 550 foot pounds $= 1.35716 \times 550 = 746.438$ watts. The decimals, however, are left off as a rule.

Example: Express 1 kilowatt hour in ergs.

$$1 \text{ kilowatt hour} = 60 \times 60 \times 1{,}000 \times 10{,}000{,}000 = 36{,}000{,}000{,}000{,}000 = 36 \times 10^{12} \text{ ergs.}$$

Dimension of the unit of power $= \frac{\text{work}}{\text{time}}$

$$= \frac{C^2GS^{-2}}{S} = C^2GS^{-2-1} = C^2GS^{-3}$$

All units derived so far may be classified as mechanical units. The electromagnetic units will form the subject of our next study.

ILLINOIS TELEPHONE ASSOCIATION.

The adjourned meeting of the Illinois Telephone Association will be held at Du Quoin on September 28 and 29. All indications point to a well-attended and successful gathering, and the programme prepared is a most interesting one. There will be one session in the afternoon of the first day, from 1 to 6 P.M., when the delegates and visitors will proceed to inspect the exhibits of the several manufacturers. The banquet will be given at 8 P.M. at the St. Nicholas Hotel. On the second day two sessions will be held, one at 8 A.M. and the other at 1 P.M.

The official programme is as follows:

WEDNESDAY, SEPTEMBER 28, 1898.

1 P.M.—Meeting called to order and address by President, Dr. I. A. Lumpkin, of Mattoon, Illinois.

Reading of minutes.

Reports from Secretary and Treasurer.

Reports from committees.

Unfinished business.

New business.

"Past, present and future apparatus," by P. J. Hertz, of the Ericsson Telephone Company, of New York City.

"The evolution of the telephone signal," by H. P. Clausen, of the Western Telephone Construction Company, Chicago, Illinois.

6 to 8 P.M.—Inspection of exhibits.

8 P.M.—Banquet at the St. Nicholas Hotel. Toasts and responses.

THURSDAY, SEPTEMBER 29, 1898.

8 A.M.—"To what extent under the present conditions should independent companies make an effort for through business?" by J. J. Nate, of the Standard Telephone and Electric Company, of Madison, Wisconsin.

"Best methods of protecting against lightning, foreign currents, cross-talk, etc., by the Stromberg-Carlson Telephone Manufacturing Company, Chicago.

"General construction of toll lines and best methods of connecting same for through and local business," by the American Electric Telephone Company, of Chicago.

"Merits of grounded, common return and metallic systems, as applicable to small exchanges," by the Sterling Electric Company, Chicago.

"Batteries for exchange and toll-line work from a point of economy and excellence of service," by S. A. Dinsmore, of the Electric Appliance Company, Chicago.

"Farm lines—Have they proven a source of revenue and should they be encouraged?" General discussion.

INTERMISSION.

1 P.M.—"Growth and development of the telephone business in the State of Illinois within the past three years," by A. M. Howell, Secretary of the Association, Hillsboro, Illinois.

"Accounts and settlements between toll-line companies," by J. W. Hamilton, auditor Douglas County Telephone Company, Tuscola, Illinois.

"Liability of toll-line companies as common carriers under existing laws and needed legislation," by Angus Leek, attorney for the Cairo Telephone Company, Cairo, Illinois.

"Progress of the independent telephone business in the West, outside of the State of Illinois," by James S. Cuming, of the Central Telephone and Electric Company, St. Louis.

Opening of the question box.

Any further business, resolutions, etc.

ENGRAVING BY ELECTRICITY.

A brief description was given recently, in a German paper devoted to electrochemistry, of a new process of electric engraving on steel and other metals for the purpose of making dies. A cast is taken in plaster of paris on the end of a cylindrical block of this material, surrounded by a hard rubber tube. The block is placed in an electrolyte, so that the lower part is immersed in the liquid, the relief of the article cast being on the upper part, which is not in the liquid. The negative pole is connected to an electrode in the liquid, and the piece of steel to be engraved is connected to the positive pole and laid on the upper part of the cast. The current will dissolve the metal wherever it is in contact with the moist cast, the metal sinking down lower as it dissolves, until all portions of it are in contact, the engraving being then finished.

Many difficulties were met and overcome in carrying out this process. The inventor uses from ten to fifteen volts and 0.2 to 0.5 ampere per square centimeter. The electrolyte is chloride of ammonium, which is first formed by the electrolysis with an iron anode. Frequent cleaning is necessary to get rid of the particles of carbon which are not dissolved, and this involves the difficulty of getting the metal back into exactly the same position. Alabaster gypsum is used, but is apt to become soft, and a machine was constructed which washes off the particles of carbon automatically.—*The Printer and Bookmaker.*

PARTY LINES.

II.—BY KEMPSTER B. MILLER, M.E.

In connecting a party line with a switchboard a great deal of trouble is often caused by the use of an improperly wound annunciator coil. It should be borne in mind that the drop magnet really bears the same relation to the line as the ringer magnets, in the various telephones, and should therefore be connected in the same way. For a series party line the switchboard drop should be wound to about the same resistance as the ringer magnets. If the resistance is made higher, as is often done in the attempt to secure a more sensitive drop, the parties on the line will have much difficulty in talking to each other, because the drop is in series in the line; but if that line is connected with some other line, through the switchboard, this trouble will not exist, as the circuits should be so arranged as to cut out the drop upon the insertion of the plug.

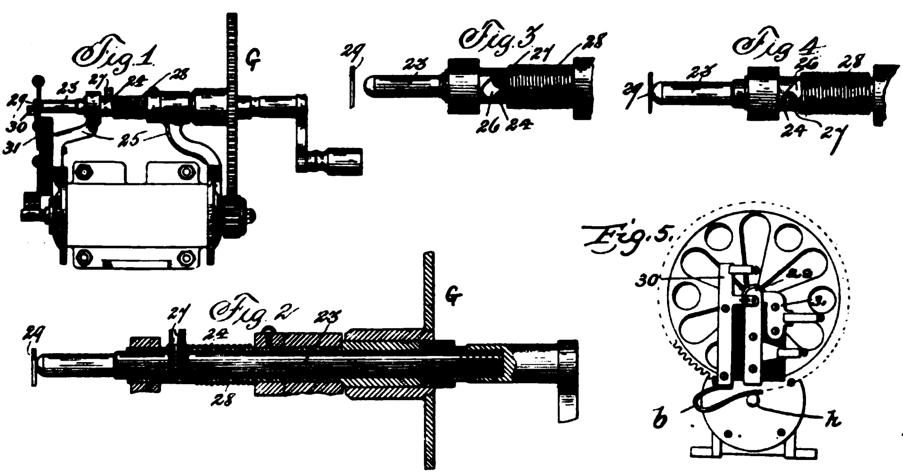
In the bridging bell system the resistance of the switchboard drop should also be about the same as that of the ringer magnets, and it should possess a high coefficient of self-induction, so as to prevent the short-circuiting of the voice currents. Such a drop may be left permanently bridged across the line, to serve as a clearing-out drop when the subscribers are through talking. In small exchanges, operating party lines, it is customary for the operator at such a switchboard to distinguish between the calls for a connection with some other line, and those which are for parties on the same line, by means of the buzz caused by the vibration of the armature of the drop. It is, therefore, desirable to give the drop armature a rather wide adjustment, so that it will make enough noise to enable the operator to readily distinguish the signals.

On lines where a measured service rate is charged, much loss of revenue is often caused by surreptitious conversations, that is, by parties on the same line calling each other and carrying on their conversation without the knowledge of the switchboard operator, so that no means is afforded for properly charging the use of the line against them. Many arrangements of circuits and apparatus have been devised for obviating this difficulty. One of these, which is suitable only for bridging lines, is to provide at the central office a switchboard drop of extremely low resistance and so arranging it that it will be cut out upon the insertion of the plug. The low resistance path through this drop acts practically as a short circuit to all of the high resistance bells on the line, so that when any party rings, nearly all of the current from his generator passes through the switchboard drop, without actuating any of the bells. When the operator plugs in for conversation, or for the purpose of calling up some subscriber on that line, the low resistance drop is cut out, so that the line is no longer short-circuited. This method cannot be used on long lines, because the resistance of the drop, in addition to that of the line wire, proves high enough to shunt some of the current through the magnets of the bells at the distant end of the line, when parties at that end attempt to signal each other. While the drop would short-circuit the end of the line nearest the switchboard, the instruments at the farther end would not be appreciably affected, owing to the high resistance of the line wire between them and the board.

This method is not, on the whole, very satisfactory, and a better one is to arrange the magnetos at the subscribers' stations to generate a current *in one direction only*, instead of the usual alternating current, and to give the armatures of the bridged call bells at all of the stations a permanent set or tendency toward the pole which would be rendered stronger by currents in this direction. The switchboard drop, also bridged across the line, is of a nonpolarized type, so as to fall when actuated by currents in either direction. Thus, when any subscriber calls, the current will have no effect upon any of the ringer magnets of

the other subscribers, because it tends only to pull the armatures closer to the poles toward which they are already attracted, but will cause the switchboard drop to fall in the ordinary manner. Thus, no subscriber can obtain a conversation with any other subscriber without the full knowledge of the operator. The switchboard generator is equipped for sending out currents, either of the opposite polarity from those generated by the subscriber's generators or of the ordinary alternating character, so that the operator may ring up the subscribers at will.

Mr. Frank B. Cook, of the Sterling Electric Company, has recently patented an apparatus for using in a system of this journaled in the brackets 25 mounted on the end plates of the machine. A pin, 27, fixed in the crank shaft 23 engages a diagonal slot 26, in the sleeve 24. This pin is held at one end of the slot by the spring 28, which is coiled around and fastened to the sleeve 24. When, however, the crank shaft is rotated, the pin 27 rides against the side of the slot 26, until it assumes the position shown in Fig. 3, after which the sleeve and gear turn with the shaft. This causes the crank shaft 23 to break contact with the spring 29; and also allows the spring 29 to break contact with the spring 30, with which it is in normal engagement, and to engage the spring 31. This breaks the shunt around the generator,



FIGS. 1, 2, 3, 4 and 5.— Details of Cook Generator.

kind. The principal feature of this invention is in the generator, the details of which are shown in figures 1, 2, 3, 4 and 5. The armature and pole pieces are arranged in the ordinary manner, but an insulating strip k, shown best in figure 5, is fastened to one side of the armature spindle, so that the spring brush b will make contact with the armature spindle during half of a revolution only. In this manner, every alternate wave of the generator will be "weeded out," so that the waves which are sent to line will be in one direction only. The shunt mechanism is operated by the crank shaft, which carries the large gear wheel. This shaft turns in a hollow sleeve 24, which is

and cuts out the receiver from the calling circuit.

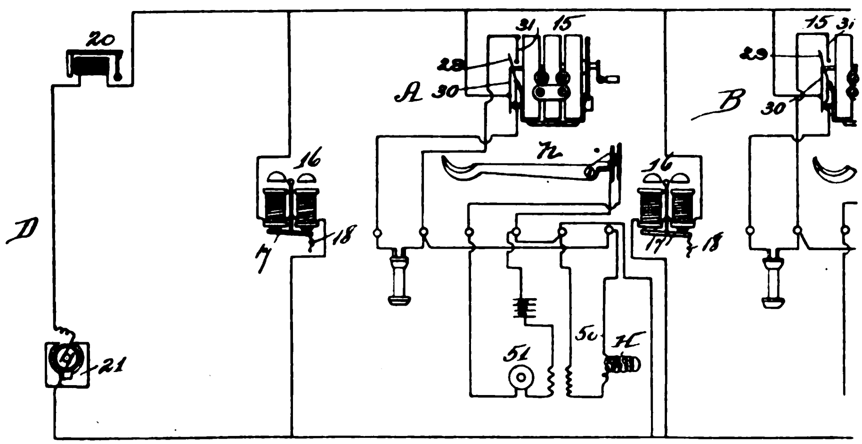
The peculiar arrangement of this mechanism has for its object the prevention of one subscriber ringing any other subscriber by turning his generator backwards, for it is obvious that a backward turn of the generator would send to line currents of the opposite polarity from those which were sent by turning the generator forward, and this would accomplish a result which might be desirable to the subscribers, if not to the managers of the exchange. A backward turn of the generator in this device will not break the shunt, and therefore will allow no currents to pass to line.

The circuit connections of an instrument are shown in Fig. 6, the switchboard generator being shown at 21, and the drop at 20. 16 are the high-wound bells bridged across two sides of the line at stations A and B. In another bridge circuit, at each station is included the generator which is normally shunted by the device described. The hook switch h serves only to open and close the local circuit containing the transmitter 51 and battery. The circuits through this bridge may be traced normally from the upper line wire to the spring 30, thence through spring 29 to the receiver, and through a resistance H, and the secondary of the induction coil to the other side of the line. This circuit is normally closed, and, were it not for the resistance H, would serve as a shunt which would greatly lower the efficiency of ringing of the bells 16. The resistance h is described as being differentially wound to a resistance of about 5,000 ohms.

In order to prevent the ringing through the receiver when the generator at any station is operated, the spring 29 automatically breaks contact with the spring 30, and at the same time makes contact with the spring 31, which leaves the receiver out of circuit entirely. It would seem that the use of the high-wound coil H which is permanently in series not only with the talking apparatus but also with the generator, would be a very serious drawback, but Mr. Cook says in his specification, "I am aware that to some this additional resistance in the talking circuit would appear very detrimental, but in practice it is impossible to detect with the telephone whether such a coil is in circuit or not." Of course the resistance, even though it be a non-inductive one in series with the generator, will always have a very decided effect; but inasmuch as the generators in this system are for the purpose of operating the switchboard drop, and not the various subscribers' bells, this defect can probably be overcome to a large extent.

This system is particularly interesting in view of recent developments, in connection with the bridging bell patent.

Fig. 6.



Circuits of Cook Bridging System.

LOCK-OUT SYSTEMS.

A very interesting class of systems has within a comparatively recent time come into existence to secure a certain degree of secrecy in party line service. In the systems so far described, there is nothing to prevent one subscriber from taking his receiver off the hook and listening to whatever conversation other subscribers may be engaged in. Another object of the lock-out system is to prevent subscribers, desiring to use their instrument,

from breaking in while the line is already busy, thus ringing in the ears of the parties who are using their telephones.

Mr. C. E. Scribner, of the Western Electric Company, has, as in nearly every other branch of telephony, been well to the front in this line. One of these systems, designed by Mr. Scribner, is shown in Fig. 7, which illustrates two subscribers' stations A and B connected by the line wires 5 and 6 of a metallic circuit with the switchboard at the central office C.

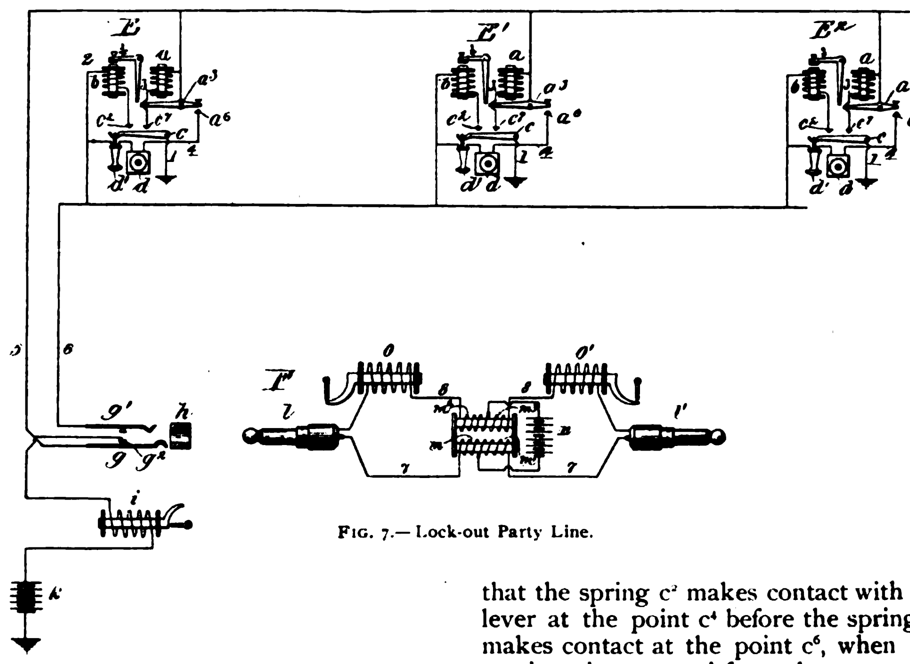


FIG. 7.—Lock-out Party Line.

The mechanism for operating the lock-out devices at each station on the party line is shown in Fig. 8. In this figure a magnet a, supported on a bracket a^1 is provided with an armature a^2, carried upon a lever a^3 pivoted as shown. The armature a^2 is normally pulled away from the core of the magnet a by the attraction of gravity, the magnet being mounted with its core vertical. The backward movement of the lever is limited by the stop a^5, and the forward movement by the contact anvil a^6, with which it makes contact when the armature is attracted. Mounted alongside of the magnet a is a similar magnet b, having its armature b^1 mounted on the short arm b^2 of a bell-crank lever b^4. The armature is normally held away from the core of the magnet b by the spring b^5 which bears against the adjustment screw b^6. When the armature b^1 is attracted by its magnet, the long arm b^4, which normally rests against the back stop b^7, is pushed sidewise and into the path of the lever a^3, so as to prevent the upward movement of the latter.

The hook switch is of the Warner type, and the contacts are so adjusted that the spring c^2 makes contact with the lever at the point c^4 before the spring c^7 makes contact at the point c^6, when the receiver is removed from the outer end of the hook. The action of these springs is the same as in the ordinary receiver hook, being such that when the hook is depressed the spring c^7 breaks contact with c^6, resting on the hard rubber lug c^5, while the spring c^2 breaks contact with c^4 and rests on the hard rubber lug c^3.

Referring now to Fig. 7, and remembering that the various parts in the apparatus shown at the substations E, E^1 and E^2 bear the same reference letters as those in Fig. 8, the circuits may be traced as follows: The telephone switch hook C is permanently connected to ground by the wire 1. The wire 2, leading from line

wire 6, includes the winding of the magnet b and terminates in the contact point c^2 which, it must be remembered, is the contact first made when the hook is raised. The wire 3 which branches from the main line wire 5 includes the winding of the magnet a, and terminates in the contact spring c^7. The wire 4 branches from the wire 2 and includes the receiver d^1 and the transmitter d, and terminates in the contact point a^6 with which the locking lever a^3 makes contact when attracted by the magnet a. The apparatus at all of the subscribers' stations on the line are connected in the same manner. The main line wires 5 and 6 terminate respectively in the springs g and g^1 of the spring jack. The spring normally rests on the anvil g^2 which forms the terminal of a wire leading through the self-restoring drop i and the battery k to ground.

The operator's circuit is shown at F, l and l^1, being respectively the answering and calling plugs of a pair. The tips of the plugs are connected together through the wire 7, while the sleeves are similarly connected through the wire 8; this latter wire including serially the clearing out or supervisory signals o and o^1. The conductors 7 and 8 each includes two helices, m, m^1 and m^2, m^3, respectively. The point between the coils m and m^1 is connected to one terminal of a battery n, while the opposite terminal of the battery is connected to the junction of the coils m^4 and m^3. The arrangement is such that the coils m and m^2 act inductively on the coils m^1 and m^3, and vice versa. When a plug is inserted into a jack, therefore, the battery n is bridged across the line, and thus supplies current directly for operating the telephone transmitters and receivers at the substations.

The apparatus is shown in its normal or idle condition: that is, with the plugs withdrawn from the jacks and with all of the subscribers' receivers resting upon their respective switch hooks. Suppose, now, that a subscriber at station E desires to be connected with some other subscriber; he removes his receiver from its hook, and the latter in rising makes contact first with the point c^2 and immediately thereafter with the point c^7. The making of the contact with the point c^2 produces no result on the magnet b, because there is no battery in circuit with the line wire 6 with which the wire 2 is connected. As soon, however, as the contact with c^7 is made, a current flows from the battery k through a coil of the drop i, thereby actuating the shutter; thence through the contact g^2 and spring g of wire 5; thence through the magnet a and wire 3 to contact c^7 and to ground, which forms the return circuit of the battery. This current, besides actuating the shutter at the central office, causes the lever a^3 to come in contact with the point a^6, thus completing the circuit between the two sides of the line through

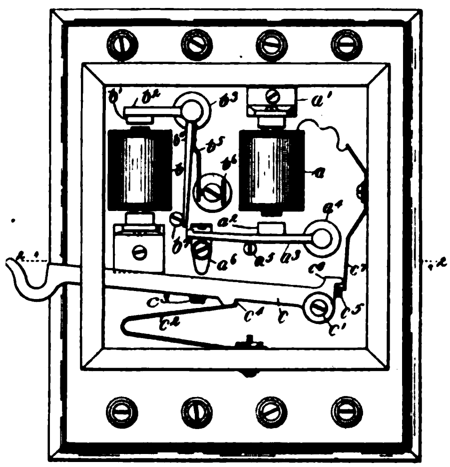


FIG. 8.—Scribner Lock-out Box.

the telephone apparatus proper. The lever a^3 is allowed to rise, for the reason that the magnet b has not actuated its armature to pull the lever b^4 into the path of the lever a^3.

The operator at the central station seeing the shutter fall, inserts the plug l into the spring jack, thus establishing connection with the line, and, at the same time, breaking the connection between the line wire 5 and the drop i. The operator's talking apparatus is not shown, but it is adapted to be bridged across the cord circuit 7 and 8 in a manner well understood. It will be noticed that no induction coil is used at the subscribers' stations, the current from battery n passing directly through the transmitter and receiver in series. This

circuit may be traced as follows: Starting at the upper pole of the battery n the current passes through coil m^2, wire 8, annunciator o, sleeve of plug l, sleeve spring g of the jack, line wire 5, lever a^3 at the subscriber's station E, contact point a^6, wire 4, transmitter d, receiver d^1, line wire 6, tip spring g^1 at the central office, tip of the plug l, wire 7 and coil m to the other pole of the battery n.

The subscriber then communicates with the central office in the ordinary manner, and is there connected with some other subscriber in the exchange by means of the plug l^1. Suppose, now, that while the subscriber at E is using

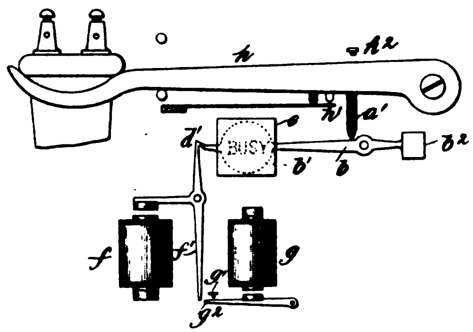


FIG. 9.— Busy Signal.

his telephone, the subscriber at E^1 desires also to use the line; he removes his receiver from its hook, and as before the lever of the hook first makes contact with c^2, and later with c^7. As soon as the contact is made with c^2, however, the magnet b at that station attracts its armature and pushes the stop-controlling lever b^4 into the path of the circuit-controlling armature a^3. The circuit through this magnet b may not be at first apparent, but may be traced as follows: From the line wire 6 through the magnet b at station E^1 to contact c^2 and to ground; thence to the ground at station E, where the receiver is also off its hook, and through the contact point c^7 at that station and magnet a to the wire 5. Current is supplied to this circuit from battery n. Since the lever a^3 at station E^1 cannot rise, it is impossible to complete the circuit through the telephone apparatus at that station at the point a^6, and is thus impossible for the subscriber at that station or at any other station to use his telephone until the subscriber at E has finished his conversation.

If the subscriber E^1 had attempted to use the line after the subscriber E had removed his receiver from the hook, but before the operator at the central office had inserted the plug into the jack, the same state of conditions would have obtained, except that the source of current would have been from the battery k; for when the subscriber at E removed his receiver from its hook, the battery k became connected with the wire 6, thus making the conditions such that when the receiver at any other station was removed from its hook the magnet b at that station would operate its lever to lock the apparatus.

The call-sending apparatus at central office and the call-receiving apparatus at the subscribers' stations are not shown, but such calling is accomplished by the use of the ordinary bridging bells.

When the subscriber at station E has finished his conversation he replaces the receiver on its hook in the ordinary manner. This breaks the connection which exists between the two sides (5 and 6) of the line, and therefore stops the flow of the current from the battery n. This allows the shutter of the clearing-out drop o to fall, it having been raised automatically by this current when the connection was established. This shows the operator that a disconnection is desired. As soon as the subscriber, who is connected by the plug l^1, hangs up his receiver, the shutter o^1 falls in a similar manner, thus indicating to the operator that both lines are free.

This system is instructive in many ways. It not only embodies a very ingenious method for securing privacy on party lines, but also exhibits the features of automatic calling on the part of the subscriber, and of the centralized transmitter batteries, now in common use by the Bell companies. The apparatus at the subscriber's station has no calling generator or batteries of any kind, all such being placed at the central office, where they undoubtedly belong.

Fig. 9 illustrates diagrammatically a mechanism for use on circuits practically the same as those in the system just de-

scribed, with the added feature that a signal is automatically displayed for indicating to a subscriber when the line is in use at some other station. In this the stop-controlling lever, represented in this figure by f', carries also a catch or hook, d', which normally engages a lever b, which carries a target marked "Busy." Assuming that the line is not busy, any subscriber who raises his receiver from the hook will obtain control of the line, as described in the previous system. The magnet f, however, not having current, will not release the lever b, and will thus hold the target in its concealed position, even though the hard rubber lug a' on the hook lever allows it to rise. If while the line is busy, however, a second subscriber attempts to use it, the raising of his receiver will withdraw the lug a' from engagement with the lever b, and in the manner already described, the magnet f will take current. This will not only lock the lever g^2, but will also withdraw the catch d' from engagement with the lever b and allow the busy signal to rise. Thus the subscriber will not only be locked out, but will be notified of that fact by the signal. Upon the replacement of the receiver on the hook, the lug a' serves to restore the busy signal, thus doing away with all magnetic resetting devices.

THE LONG-DISTANCE TELEPHONE AND RAILWAY TRAVEL.

That the more and more extended use of the long-distance telephone between the larger cities would seriously affect the passenger travel on the railroads would hardly be believed except by those who have given the subject close attention. Not only has the travel been much diminished, but according to the statement of a railroad official the business of one of the limited trains between New York and Chicago has been practically ruined by the telephone, says the *Railroad Gazette*.

This result is not very surprising. One of the definite objects had in view in putting on 25-hour trains between New York and Chicago was the accommodation of brokers and business men of Chicago and the Northwest, who demanded quick time. Their trips to New York were taken on occasions of utmost importance, when a little time meant thousands of dollars. By means of the "Limited" the broker or business man was taken to New York in the quickest possible way. He talked as fast as he rode and made an equally quick return to Chicago. The business man was willing to pay the price assessed for this development in rapid transit.

The patronage of people whose time was less valuable to them was not expected to contribute much to the income of these trains, so that their whole dependence was expected to be, and was, on two classes: the business men aforesaid and pleasure travelers to whom a few dollars extra was not a noticeable item. Then came the introduction of the long-distance telephone. People at first were slow in realizing its benefits. Slowly but surely they have, however, come to appreciate its significance. A broker or grain dealer in Chicago has in mind a "big deal"; he telegraphs to New York asking for certain information and adds: "Call me up by long-distance telephone and give me your answer." The result is that for $15 or $20 a talk is held with the New York man. Having received the telegram, he has had an opportunity to concentrate his expressions to the shortest possible statements; he has even jotted them down, and at the proper time calls up his man and transacts his business. So it is done every day. Half a dozen grain men who had been in the habit of making frequent trips between Chicago and New York said that for $3 or $4 they could now transact business which formerly required a three-day trip.

JOHNSON says: "All the performances of human art, at which we look with praise and wonder, are instances of the resistless force of perseverance."

MILWAUKEE, WIS.—A new corporation, called the Citizens' Telephone Company, has made application for a franchise. It claims to have 1,600 subscribers promised, and that a franchise will be granted whenever it is ready to install the plant.

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CHICAGO, SEPTEMBER, 1898.

IF there is any doubt in the minds of the pessimists as to the soundness and stability of the independent telephone business, they should carefully peruse the contents of this number of the TELEPHONE MAGAZINE. In it they will find not only a complete description of some of the finest independent exchanges ever built, that rival in quality of construction, perfection of mechanical and electrical details and efficiency of service any of the Bell plants, but they can also read about the great strides that have been made by our manufacturers in bringing their several types of apparatus to that high state of perfection which is necessary in giving first-class service. The independent telephone business is today by far the most active branch of the electrical industry of the United States. Capital no longer hesitates to go into the business, a large number of new exchanges are being established, while existing ones are being extended, and in all quarters the independent movement is gaining strength. The number of first-class, paying, independent exchanges throughout the country is proof of the unqualified success of the movement.

THE chapter on "Multiple Boards," in the Wietlisbach telephone articles, intended to appear in this issue, will appear in our October number, after which the succeeding chapters will follow regularly.

OUR very highly esteemed contemporary, the *Western Electrician*, in its issue of September 3, speaking of the recent change in ownership of ELECTRICAL ENGINEERING, and touching upon the policy of the new management, says:

. . . Thus freed from all entangling alliances, Mr. Kammeyer announces his intention to follow the fortunes of the independent movement. The *Western Electrician* extends its sincere congratulations to Mr. Kammeyer personally, as well as in his capacity as publisher, upon his decision to discard the obnoxious policy of the former management of ELECTRICAL ENGINEERING and follow the example of the *Western Electrician* in its advocacy of the independent telephone interests of the country.

This is all very nice and much appreciated, but when it comes to "advocating the independent telephone interests of the country" this paper must be credited with being the pioneer. There is only one independent telephone paper in the world, and that is the TELEPHONE MAGAZINE.

THROUGH one of those inexplicable combinations of circumstances that can only occur in a printing office, the types were made to say, in one of the news items in our August number, that the Des Moines Mutual Telephone Company had contracted for a 2,000-line Stromberg-Carlson switchboard, when the well-known apparatus of the *Sterling Electric Company* should have been mentioned, whose apparatus was selected after a critical examination of several other types.

THE "STREET RAILWAY JOURNAL" FOR SEPTEMBER.

The appearance of the annual souvenir convention number of the *Street Railway Journal* has for years past been looked to with a certain amount of curiosity and pleasurable anticipation, not only by the street railway trade in general, but also by all who love to see an example of what is unquestionably the most elaborate and imposing production in the way of a trade publication. The current issue fully sustains the reputation the *Journal* gained long ago as the peer in its class. Its size, typographical execution, character and quality of reading matter, are beyond criticism.

The leading article, "Street Railway and Financial Results in Metropolitan Boston," gives a comparison of the financial characteristics of the thirty-one street railway properties in and about the city of Boston, and will prove of special interest to street railway capitalists.

The latest plans of "The Boston Subway" and the subway stations, as finally carried out, are described in another equally attractive article, while a number of special contributed articles, illustrated descriptions of the latest developments in electric railroading, and a host of other valuable items and news, combine to make up what is undoubtedly the most elaborate trade journal ever published.

AMERICAN STORAGE BATTERIES IN TELEPHONE EXCHANGES.

It has only been during the past year or two that the centralizing of the batteries or other current-generating devices at one point has been more and more recognized as the most economical and efficient practice by exchange managers in general. One of the first manufacturers to supply dependable storage batteries for this kind of work is the American Battery Company, Chicago, whose cells are probably more extensively used in exchanges today than any other type. There are a number of instances where storage cells can be economically applied, especially when charging current from light or power circuits is available some part of the twenty-four hours. For operating switchboard transmitters, automatic signaling and switching devices, driving motor-generators and also for supplying transmitter current to subscribers in the central energy system, storage cells are the most desirable. The sizes as now supplied by the American Battery Company for general telephone work vary in capacity from 2.5 to 450 ampere-hours, although elements of as high as 2,000 or 3,000 ampere-hours, for special work, will probably be soon in demand.

Among the exchanges where American cells are used for transmitter work, may be mentioned: Chicago, Ill., Akron, Ohio, Peoria, Ill., Quincy, Ill., Muncie, Ind., Rockford, Ill., Indianapolis, Ind., Newton, Kan., Lima, Ohio, Fort Wayne, Ind., and Toledo, Ohio.

For operating Strowger Automatic Switches the company has furnished cells at Augusta, Ga., Rochester, Minn., Albuquerque, N. Mex., and other places.

The Little Lady and the Telephone.

[*New York Journal.*]

There are bells galore in Gotham
  Making music all the time;
They are brazen, they are golden,
  And they peal in merry chime;
But to only one I listen —
  One that's mine, and mine alone;
She's the belle of Central Office,
  And she rules my telephone.

With the sweetest little,
  Neatest little,
    Fleetest little ring,
That echoes through my office
  In a mellow ting-a-ling;
She tells me that she wants me
  And all cares aside I fling,
As I swiftly fly to answer
  My 'phone belle's little ring.

She's a dainty, dimpled darling,
  And she sets my heart afire
When her words in shyest whispers
  Lightly flit across the wire;
And I swear that no bell ever
  Had so musical a tone
As the belle that "rings up" daily,
  And calls me to the 'phone.

Oh, that queerest little,
  Clearest little,
    Dearest little ring!
What visions rise before me
  When I hear its ting-a-ling!
What dreams of bliss unending
  Its mellow echoes bring,
As with happy heart I answer
  My 'phone belle's little ring!

THE VICTOR STRAIGHT METALLIC EXPRESS SWITCHBOARD.

In the development of exchange switching apparatus, many attempts have been made from time to time to produce a board that would fulfill all the requirements of an ideal switching apparatus, and especially one that would be a straight metallic circuit board in every respect. In designing and constructing the Victor Express Switchboard, detail views of which we herewith present to our readers, the Victor Telephone Manufacturing Company has succeeded in producing what is one of the most efficient and most perfect pieces of electrical mechanism in the market today.

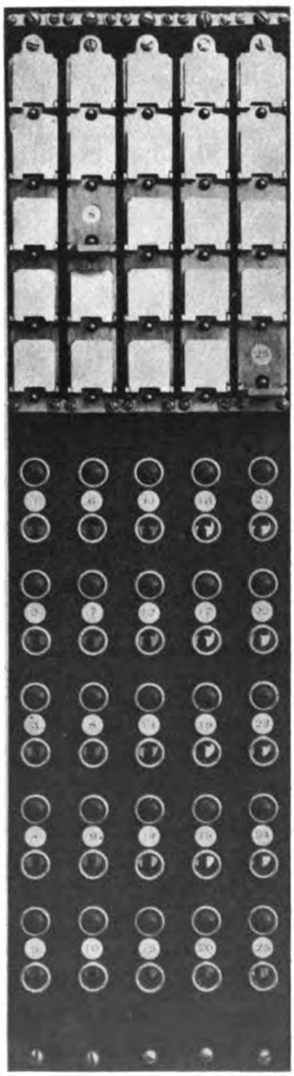


FIG. 1.

By adopting as a basis a straight metallic system with double circuit cords, and with the ringing and listening circuits normally cut out on both sides, an exchange using this board can easily be divided into metallic, common return or ground circuits, and still have each division separate from the other. This is certainly of great advantage to exchanges that wish to adopt the metallic system and gradually change over the old circuits. Owing to the mechanical construction of the Victor express board, this can be done without any change whatever in the wiring, and as the boards are made up in complete sections, each of five complete drops, jacks and individual ringing keys, any section can be easily and quickly inserted or removed by even the most inexperienced person.

In Fig. 1 is shown a front view of five such sections, assembled ready for placing in position in the cabinet. The drops are arranged vertically, beginning at the top, and are numbered in the same manner or in any other way as may be convenient. For numbering, little card or celluloid disks are furnished, which are pressed into recesses made in the front strip. For numbering or lettering trunk or toll-line sections, blank disks are furnished when necessary.

Below the drops are placed the jacks and ringing keys, arranged in the same way. An individual ringing key is provided for each line, so that any subscriber can be called, whether the plug is in the jack or not, or if any two subscribers are connected either one can be called without ringing back on the other line.

In the side view, Fig. 2, the arrangement of drops, jacks and keys is very clearly shown, the upper drop being removed, showing the ease with which this can be done, it being merely necessary to rotate the drop one-quarter turn and withdraw it from the strip.

In Fig. 3 the wiring details and the arrangement of the several parts in gen-

eral are shown to good advantage. The wiring of each section is complete in itself, all wires being concealed in a vertical groove, so that when the board is connected up no wires either on the front or back are visible. All of the connections are, of course, carefully soldered, and the wires insulated with the best quality of para rubber.

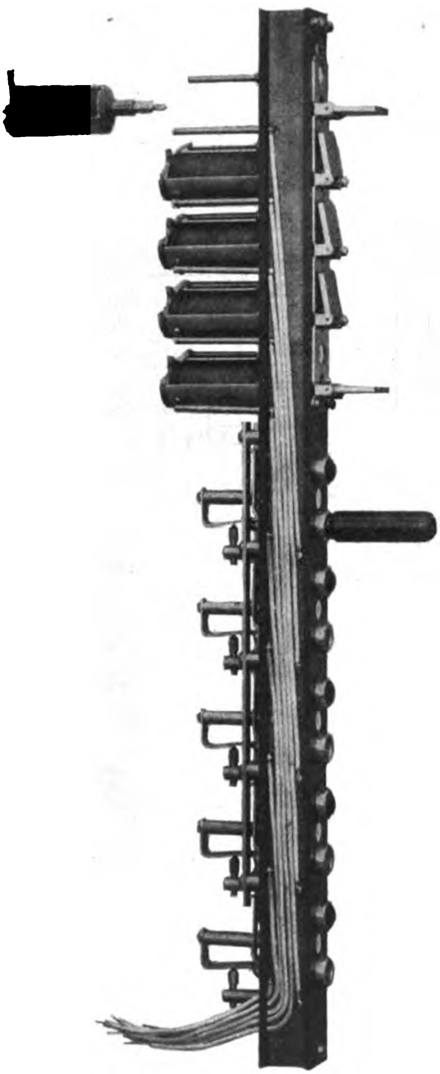


FIG. 2.

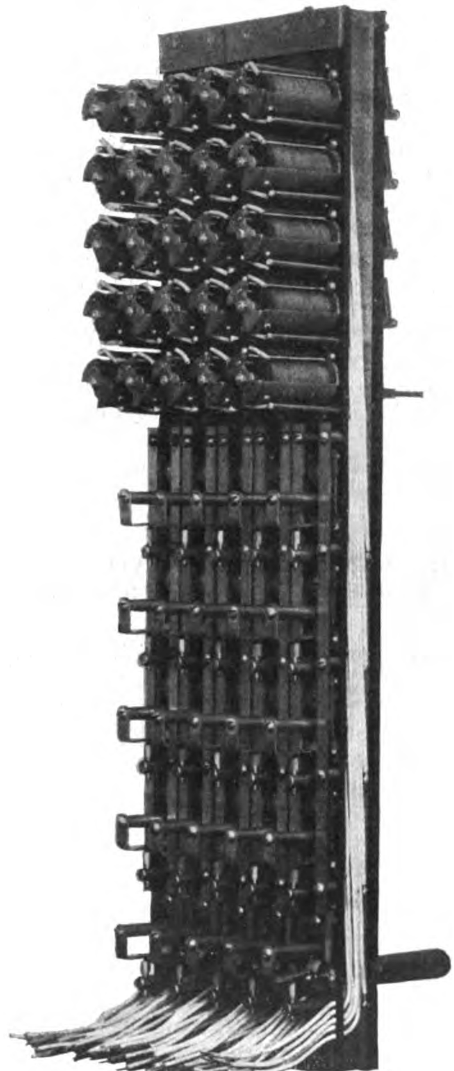


FIG. 3.

In the construction of the drop magnet several novel features have been employed. It is of the tri-polar type, with the armature placed so as to obtain the highest possible efficiency. The coils are wound in even layers with silk-covered wire, and can be removed without taking out any screws. As the coils are *not in series*, there is no retardation or counter electro-motive force to affect the telephone current. Consequently, to change to a toll-line jack, for very long distance work, it is only necessary to replace the drop coil with one of higher resistance.

The night-bell connection is made in such a manner that there is no metal connection between the drop coil and the shutter, leaving the coils thoroughly insulated from each other, with no possible chance for leakage of current and consequent cross-talk.

It is the claim of the Victor Company that owing to the fewness and stability of parts, economy of maintenance and lasting qualities, purchasers of this board secure a saving of fifty per cent in the equipment of an exchange, although the first cost is no higher than that of the best board on the market.

It is evident to even the most casual observer that in the entire design and construction of the apparatus the intention has been to provide a board that embodies the greatest ease and rapidity of operation consistent with durability and simplicity of construction. How well the Victor Company is succeeding in accomplishing its purpose may be judged from the daily increasing number of satisfied customers using Victor apparatus.

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE SYSTEM IN ENGLAND.*

In an article in the *Electrician* for May 6 last, page 52, a description was given of the automatic telephone exchange system of the Direct Telephone Exchange Syndicate (Limited). This article described a system in which all the mechanism and contacts were included in a single instrument for each subscriber, the limiting capacity being 400 subscribers. An extended system has been devised to accommodate up to 10,000 subscribers, and this was briefly referred to in the article. These larger capacity exchanges are equipped with what the designers term the "bridging" system. The working principle and the mechanism are the same as that described in the article referred to above, but the circuits are slightly different; a system of junction wires being employed in the exchange which gives every subscriber access to all other subscribers without requiring such a large number of wires as might have been expected in such a system. The advantages of this bridging system are that the operating magnets for working the instruments, being connected across the circuit, maintain a balanced circuit, and not being talked through, can be of high resistance, or about 300 ohms; the working current is, in consequence, only about 0.2 ampere,

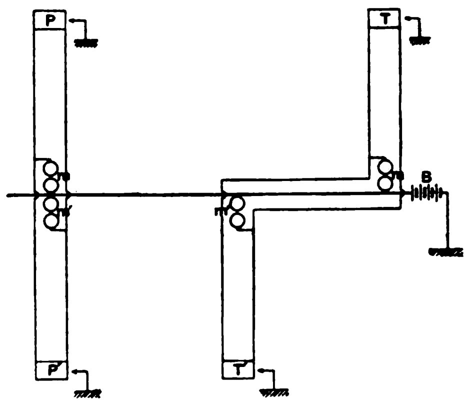


FIG. 1.—Diagram of Talking Circuits.

and it is possible to operate over long lines using the earth as the return in the calling circuit, but the second wire of the line as return when talking; the line construction is, therefore, similar to that used in metallic-circuit systems.

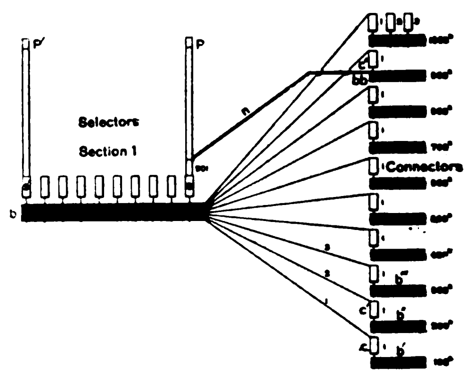


FIG. 2.—Diagram of Section of a 1,000-Subscriber System.

Fig. 1 diagrammatically shows the talking circuits. P and P' are two telephones connected by a metallic circuit which is bridged by the two pairs of magnets *m m'* in series. T T' indicate two similar telephones whose mechanisms

* London *Electrician.*

are at different positions of the exchange switchboard; the operating battery, one pole of which is put to earth, is shown at B.

Two sets of mechanism or switches are used in the exchange for each subscriber. The first enables him to select the hundreds or the thousands and hundreds, as the case may be, of the subscriber's number he wishes to call up; by the second instrument he selects the tens and units of the number wished for. For the 1,000-subscriber system the numbers range from "001" to "999," and for the 10,000 system from "0001" to "9999," so that in the 1,000 system three motions, and in the 10,000 system four motions are necessary to call up a number required.

In a 1,000 system the selectors are arranged in sections of 10 selectors each. Each section gives access to 10 connectors — one for each hundred up to 1,000, thus making a possible $10 \times 100 = 1,000$ connections. Fig. 2 is a diagram of the circuits for one such section, with its ten corresponding connectors.

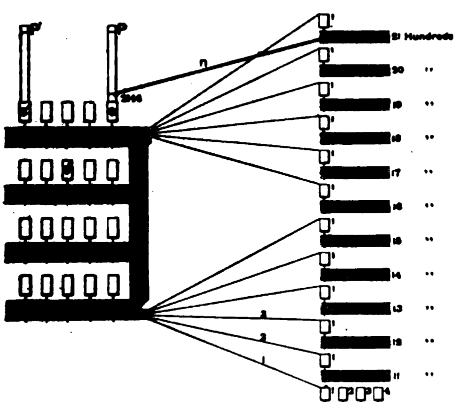


FIG. 3.— Diagram of One Group of a 10,000-Subscriber System.

Each selector, S S′, etc., has access to ten circuits, *b*, and each of these circuits leads to a connector switch, 1, 1, 1, etc.; each of these connector switches is given the same number as the section to which it belongs, and it has access to 100 pairs of talking circuits, *b′*, *b″*, *b‴*, etc., which are taps from the subscriber's line wires, as shown at *n*. As an example, if telephone P′ wishes to call P (No. 901), the switch S′ first selects the ninth circuit of the wires *b*, then the connector C″ selects the first circuit of the wires *b b*; the circuit is now complete through the wires *n* between P′ and P.

The system of grouping in the 10,000 system is similar in principle to that in the 1,000 system just described; in the 10,000 system, however, the selectors are arranged in 100 sections of 100 each and each group has access to 100 connectors — one for each 100 in 10,000 — thus giving a possible 10,000 connections.

Fig. 3 shows a diagram of the circuits of *one* such group, with a part of the attached connectors. In either system the talking circuits are completely metallic, the lines 1, 2, 3, etc., in the diagrams representing a double wire.

In the exchange itself the longest connecting wires are 36 feet, and these are unconnected with anything except individual lines until a call is made.

COMMUTATOR LUBRICATION.

In all electrical machinery where a commutator is one of the necessary parts of the apparatus, it invariably performs what by some has been called the most important function of any of the parts. Whether it be on one of the immense generators supplying power to miles of trolley lines, or the small ring of copper segments of the miniature dynamo which charges the signaling battery in a telephone exchange, in either case proper lubrication is of the greatest importance. It is usually the employment of improper so-called lubricants, such as oils, vaseline and the like, that results in the rapid wear and final destruction of the commutator.

Nearly all oils and petroleum products carbonize under the action of the electric spark, and their improper use in many cases aggravates the trouble instead of remedying it. It is only by the intelligent application of a well-known and scientifically prepared compound, such as Gale's, that a commutator can be kept in proper condition and made to retain that high gloss so much desired by the careful engineer.

LIQUID AIR AS A COMMERCIAL PRODUCT.*

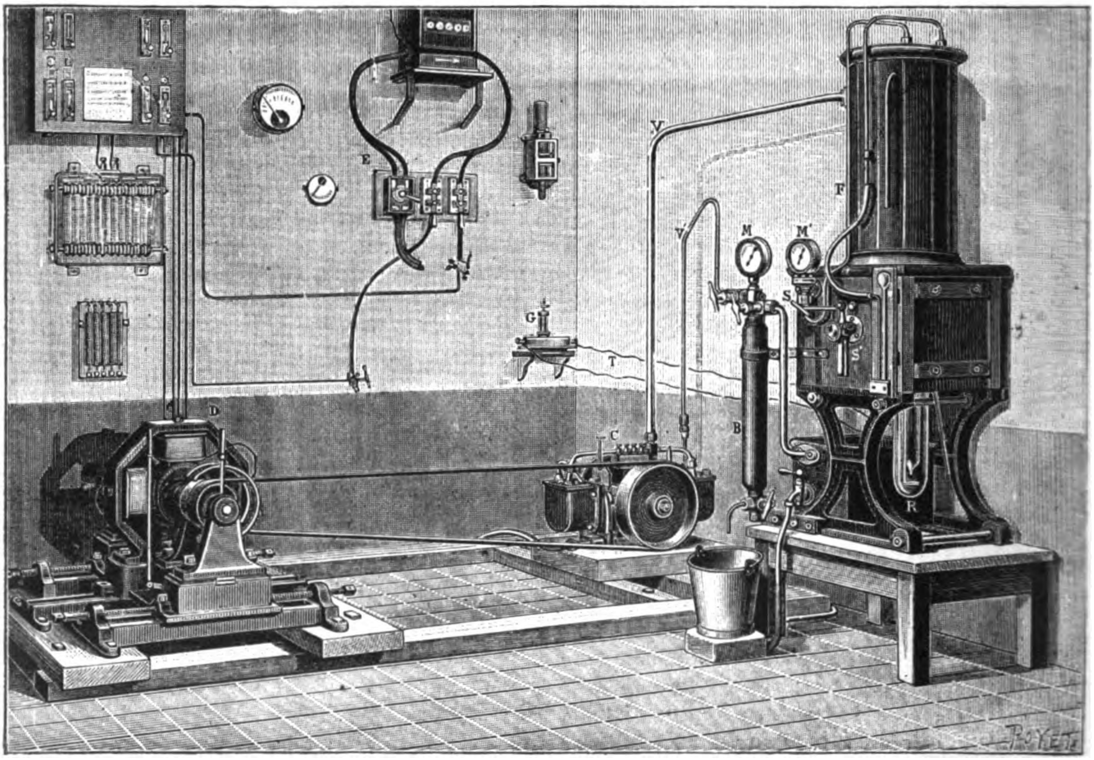
In the condensation of air we have proof that it is not a permanent gas, as was formerly believed. For illustration, the air of the atmosphere may be considered as a superheated vapor, from a liquid having an extremely low temperature boiling point.

The critical temperature of air at atmospheric pressure being given by one authority as 140 degrees and by another as 190° Cent., it follows that if air be reduced to or below its critical temperature it will cease to be a gas and will become a liquid. This has been accomplished by subjecting the air to pressure, reducing the resulting temperature, and finally allowing it to expand to atmospheric pressure, when liquefaction will result.

There are now two practical methods for reducing air to its liquid form — that employed by Charles E. Tripler, of New York City, and the method and apparatus used by Dr. Carl Linde, of Munich, Germany, who is famous as the inventor of the ammonia refrigerating machine bearing his name.

In the earlier laboratory efforts in this line the air was compressed in what might be called a surface condenser, when it was cooled by the evaporation of liquid ethylene in a vacuum, the ethylene vapor being removed by a pump. Another pump compressed this vapor to its liquid, when it was cooled by the evaporation of liquid carbon dioxide, which was also compressed and cooled by circulating water. It was by this method that Professor Dewar conducted his original experiments.

The apparatus of Tripler and that of Linde are quite simple as compared with the ethylene scheme, and are calculated to produce a commercial product.



LINDE LIQUID AIR APPARATUS AT THE COLLEGE DE FRANCE.

*Modern Machinery.

The following description applies to Linde's apparatus, as made in the original and simplest form, which is shown in Fig. 1. The pump P delivers air compressed to a high pressure to the water cooler, K J L, where the heat generated by compression is removed. The air then passes through the pipe B, which runs inside of a larger pipe C (making a combination called a spiral interchange, shown by D E), and escapes through the throttle valve R into the chamber T, and thus by expansion from high pressure to low is much reduced in temperature. The air then returns by F through the outer pipe of the interchanger to the pump, and being in contact with the inner pipe, cools the air as it comes from the water cooler on its way to the throttle valve.

Fifteen hours' working with this apparatus produces such an accumulated cooling effect that liquid air begins to gather in the vessel T, and can be drawn off by a cock V. To make up for leakage or for that drawn off in liquid form, more air is forced in at A by a special pump. Thus it is apparent that the heat in the air gathered by this accumulating process is carried away in the circulating water in the cooler K J L.

The two elements of air, oxygen and nitrogen, liquefy together and produce a nearly colorless fluid, with a slight bluish tinge, which may be kept in an open vessel for several hours before it will all evaporate, the length of time depending on the quantity and means of insulation used to keep the heat of the atmosphere from it. The liquid, however, must not be confined, as it develops an almost irresistible pressure. This remarkable slowness of evaporation is accounted for by the supposition that the evaporation produces such an intense refrigerating effect that it holds the process in check.

As evaporation takes place the nitrogen passes off first, while the oxygen evaporates slower, so that as the process goes on the remaining liquid becomes richer in oxygen. The following table gives different states of the liquid under slow evaporation:

m Per cent of liquid not yet evaporated.	*a* Per cent of oxygen in liquid.	*b* Per cent of oxygen in vapor coming off.	*n* Per cent of original oxygen still in liquid.
100	23.1	7.5	100
50	37.5	15	80
30	50	23	65
20	60	34	52
15	67.5	42	43
10	77	52	33
5	88	70	19

Table *m* is the percentage of the whole liquid which remains at each stage in the evaporation; *a* is the percentage of oxygen in it; *b* is the percentage of oxygen in the vapor then coming off, and *n* is the percentage of the original quantity of oxygen which still remains in the liquid.

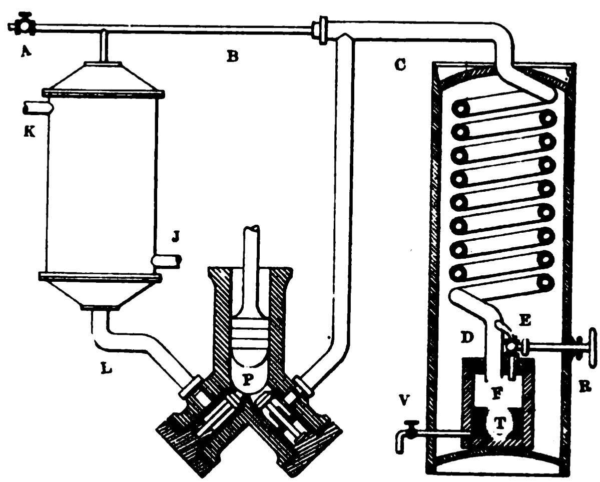


FIG. 1.—First Form of Linde Machine.

As a liquid, oxygen is considered to be of especial value in many ways. Doctor Linde has made an apparatus designed to produce a liquid rich in oxygen, which is shown in Figs. 2 and 3. As shown in Fig. 2, the interchanger is made in two parts, down through which the air passes, joining at A, then through a single pipe and coil to the throttle valve C, when it is discharged into the receiver B. The gas given off in B is principally nitrogen, and it passes out through one of the interchangers. The resulting liquid escapes slowly through the valve D, and evaporates through the other inter-

changer. The gas passing off at N consists principally of nitrogen, while that passing at O is mostly oxygen, which is the desired product. Both these gases cool the incoming air through the medium of the interchanger.

The latest Linde apparatus is shown in Fig. 3. There are two throttle valves, *a* and *b*. All the compressed air passes through *a*, but only about one-fifth passes also through *b*. The passage through *a* causes a drop in pressure from 200 atmospheres to 16 atmospheres, and four-fifths of the air in circulation passes back at that pressure through the middle one of the three tubes composing the interchanger to the pump *d*. The remaining fifth passes through *b*, and about one-fourth of it gathers as liquid in the vacuum-jacketed vessel C, at a pressure which is only enough above that of the atmosphere to allow the liquid to pass out when the stop cock *h* is opened. The unliquefied or revaporated part of what has passed through *b* escapes through the outermost tube of the interchanger. The pump *e* takes in fresh air from the atmosphere, compresses it to 16 atmospheres' pressure, and delivers it so that it mixes with the air which is returning at that pressure from the middle tube of the interchanger to the pump *d*. The compressed air, on leaving each pump, passes through a coil in a water-cooler, which also serves to jacket the pump. A small quantity of water is drawn in along with the air by the low-pressure pump, and this, together with the natural moisture of the air, is extracted as completely as possible, first by means of a separator *f*, and then by passing the compressed air through a coil *g* in a bath of ice and salt before it goes into the interchanger. The interchanger is inclosed in a case packed with sheep's wool.

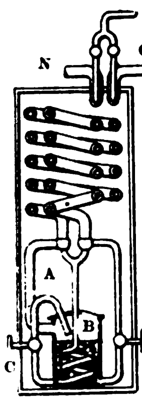


Fig. 2.— Another Form of Linde Machine.

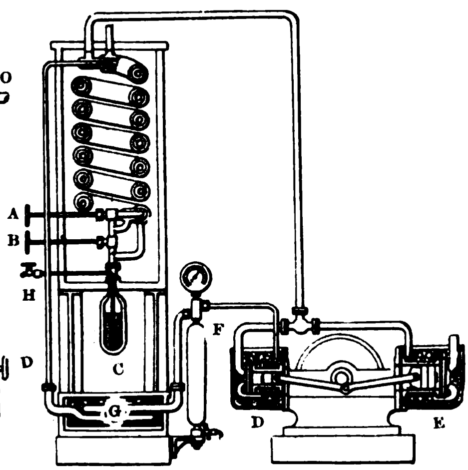


Fig. 3.— Latest Form of Linde Machine.

The Tripler apparatus is shown in Fig. 4, and corresponds in principle and action with that of Linde. Mr. Tripler claims priority of invention.

The air is compressed to 2,000 to 2,500 pounds per square inch, and the liquefying apparatus consists of a series of coils of pipe arranged in several concentric cylindrical compartments in the two large liquefiers shown in the illustration. The coils of pipe terminate in a specially designed expansion valve and an orifice. The high-pressure air entering the liquefier passes through the coils until it reaches the expansion valve. Here the air is expanded in the chamber to very nearly atmospheric pressure, and in expanding from the high pressure of 2,500 pounds is reduced in temperature, and this cold expanded air in passing over the coils from which it has just issued reduces the air under high pressure therein contained to so low a temperature that it is in part liquefied. With this apparatus, it is said, liquid can be drawn off within fifteen minutes from the time of opening the expansion valve.

A three-stage straight-line Norwalk air compressor is used, with 16-inch steam cylinder, and with air cylinders of 10½, 6⅝ and 2⅝ inches diameter, all of 16 inches stroke. The illustration does not show the steam cylinder, but, as appears, the air is water-cooled between the different compression stages.

Many uses for liquid air have been suggested, some of which are of a practical commercial nature. Among the latter the most prominent are those of

power transmission, the operation of power motors, refrigeration, and its use as an explosive.

In connection with power transmission and use in motors, or air engines, Mr. Frank Richards, the compressed-air expert, has made some calculations, assuming that the fluid could be confined and used under conditions suitable for the purpose, and has arrived at the conclusion that Mr. Tripler's compressor would use 75 horse-power and yield less than two-thirds of one per cent of the power used, for the purpose of driving an air motor at 100 pounds initial pressure. This would be a loss of ninety-nine per cent, which would, of course, preclude the use of liquid air for power in the present state of the art of manufacturing it.

On the subject of refrigeration, Mr. Richards, stating that the best ice-making plants yield seven pounds of ice per pound of coal, assumes that the Tripler compressor would use four pounds of coal per horse-power hour, which would be equivalent to 2.044 pounds of ice, as compared to about one per cent of the extremely cold liquid, which could only be used with difficulty.

In its use as an explosive, under certain conditions liquid air may find a practical application. As yet it has been only used experimentally in some German coal mines. But the difficulty in handling is serious, as it cannot be confined in cartridges; neither can it be kept, when prepared for use, more than a very few minutes, owing to evaporation. But indications are that where a regular amount of blasting is done on a large scale, this fluid has advantages. For this purpose the liquid, rich in oxygen, is used to saturate charcoal in small pieces, which is quickly made into a loose paper cartridge, and detonated in the same manner as dynamite. It has the advantage that the resulting temperature is not high, thus avoiding the possible ignition of fire damp in coal mines.

Liquid air is, however, a most valuable agent in laboratory work, scientific research and investigation. By its use the temperature of absolute zero, no doubt, will be obtained, enabling further investigation of the theory of heat. The effect of temperature on metals may be studied to advantage by its use. The effect of extreme low temperature on colors is another field for investigation.

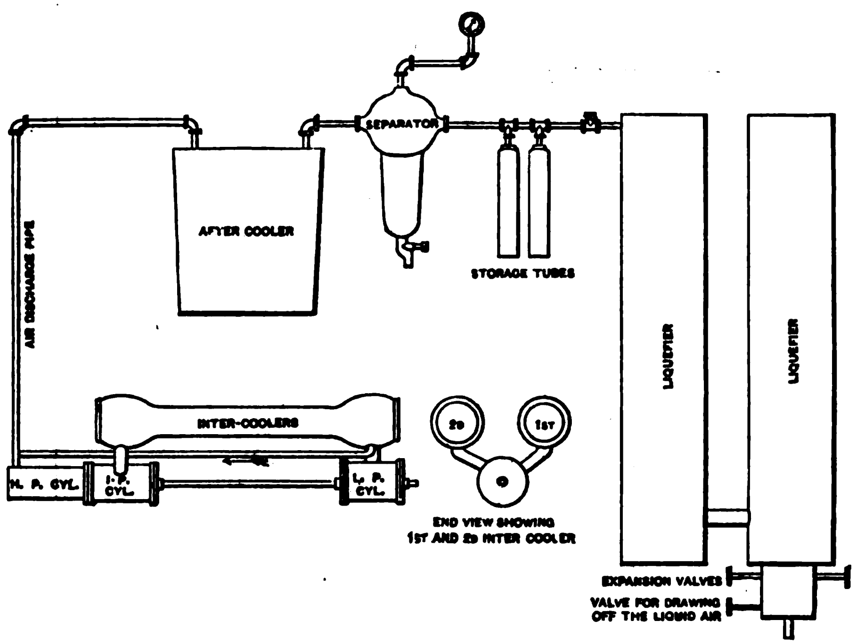


FIG. 4.—Apparatus Used by Charles E. Tripler in Producing Liquid Air.

Its powers as an analytical agent promise an important field for development. Promises of important uses in medical science are made. In this connection, a Russian physician, by its agency, maintained a room at a temperature of 100° Fahr. below zero. After a dog had been confined under these conditions for ten hours he was found to be in good condition, and had an enormous appetite. The experimenter then subjected himself to a period of ten hours in the dry, cold and still atmosphere, and found that his system was greatly stimulated, and the intense combustion required by the system to keep warm resulted in a great desire for food. Continuation of the experiments had the effect of making both man and dog more vigorous. In this case it is assumed that an atmosphere high in oxygen was employed.

In the way of commercial uses for liquid air, Doctor Linde is now having built for the Rhenania Chemical Works, at Aix-la-Chapelle, a 120 horse-power machine, which is expected to produce about eleven pounds of liquid per horse-power hour. This machine will be used to improve the Deacon process for making chlorine. The office of the machine will be to substitute a gas rich in oxygen for atmosphere, and to effect chlorine separation by the agency of cold, without compression.

It is, of course, true that where cost is not an item of importance, that very great refrigerating effects may be produced by liquid air. This holds true also of its use for power, provided a means of utilization is secured, as the energy that may be confined in a small space is enormous, and the possibilities in this direction will appeal to scientific inventors.

One of our illustrations shows a Linde machine in the laboratory of M. d'Arsonval, in the College of France, of which the parts are as follows:

B, device for separating the air from steam; C, air compressor; D, electric motor; E, induction end of the electrical battery; F, condensing coils; G, Arsonval galvanometer; M, gauge indicating up to 220 atmospheres; M', gauge indicating up to 20 atmospheres; R, glass vessel for receiving the liquid air; S, first detention stop cock; S', second detention stop cock; T, thermo-electric wires in connection with the galvanometer indicating the temperature of the air; V, low-pressure pipe; V', high-pressure pipe.

THE DEVELOPMENT OF THE TELEPHONE.

Under the above suggestive title General Manager E. C. Bickel, of the Elkhart (Ind.) Telephone Company, has issued a neatly executed brochure, describing the history and development of Elkhart's telephone service, from the time of its inception, some seventeen years ago, up to the installation of the modern 500 Metallic-Circuit Stromberg-Carlson Switchboard, together with all the accessories and appliances that contribute to the perfect service of a modern exchange.

The story of the company's struggle for success in the face of the well-known tactics of the Bell Company makes most interesting reading, and the photographic reproductions of the several switchboards, installed by the Elkhart Company during its progress of prosperity, form an optical demonstration of what can be accomplished by carrying out a policy of fairness and equity, backed by the good will of the people. The example set by Manager Bickel in thus putting the telephone question before his subscribers in the most attractive and interesting manner might be profitably followed by others, who would thereby come in closer touch with their patrons.

PERSONAL.

MR. GEO. A. MCKINLOCK, President of the Central Electric Company, took advantage of the Street Railway Convention to enjoy a few days' respite from the many business cares connected with his office.

MR. JOHN T. MCROY, the genial gentleman who manufactures the conduit bearing his name, also attended the Street Railway Convention, presumably to convince the delegates that telephone and telegraph wires are not the only conductors which should be placed out of sight.

ACETYLENE AND ELECTRIC LIGHT PLANTS.

BY C. E. LAKE, E.E.

When "Tip" Wilson made the discovery that crushed lime and coke could be fused in an electric furnace in quantities that made acetylene a commercial product, he had two requisites for turning his discovery into money. One was a clear idea of the value of the patents obtainable on the process of making crystalline calcium carbide, and the other was a very decent idea of the capabilities of Tip Wilson.

A dozen years ago Tip used to work in Woods' arc-lamp factory, in Brooklyn, and as the best ideas frequently come to those engaged in electrical pursuits, so Tip stumbled on to the invention that has made him a fortune.

Even at that time he was too good an inventor to prove a good workman. Frequent changes of occupation brought consequent cycles of good and bad luck, so that Tip knew the pain of hunger as well as the pleasure of spending money.

When, therefore, he brought his discovery to the notice of the prominent gas people of New York, and asked a million dollars for what he had, Tip was entitled to credit; but when he actually sold the rights to his invention for a quarter of a million, and got it, he was certainly entitled to the cash as well as the credit. Being a Canadian and inheriting a bump of Scotch caution, he reserved the Canadian rights as a possible means of controlling the Canadian government, and giving employment to half the population of Canada. At least, that is the way Tip explained the matter.

This was four years ago, and the fact that Tip has probably spent most of his money simply proves him a young man of vast ideas, and that his discovery was a mere incident in his career as an inventor.

The value of the Wilson process lies in the fact that in fusing lime and coke, by means of the electric current, in nearly equal proportions, into calcium carbide, from the latter acetylene gas can be made at a price which successfully competes with other illuminants, because of the cheapness of the materials employed in its manufacture.

Carbide was made sixty years ago, and has since been in constant use in laboratory work, but previous to Wilson's discovery it cost probably an average of $1 per pound, giving an equivalent in lighting effect equal to ordinary city gas at the rate of $20 per 1,000 feet.

The present price of American carbide is $70 per ton in car lots, and the quality runs close to five cubic feet of acetylene per pound of carbide, which places acetylene, with present devices for its use, on the basis of ordinary gas at $1 per 1,000 feet, or electric light at 10 cents per 1,000 watts, or ½ cent per hour per 16 candle-power incandescent lamp.

At this price the demand exceeds the present supply, which is being increased as rapidly as money and brains can do so. Up to this time the demand for calcium carbide has increased faster than it has been taken care of. When the present increase of 20,000 horse-power in the "Soo" works is completed, it looks as if the price of carbide will be reduced.

Up to this time, however, no one can determine exactly at what price carbide can be made, as it has never yet been manufactured on a sufficiently large scale. The present output of the Canadian works at St. Catherines is three and one-half tons per day, and that of the Niagara and "Soo" works fifteen tons per day.

These are the only carbide works in commercial operation in this country, the latter two being operated by the Union Carbide Company, the only American licensee under the patents of the Electro Gas Company, of New York, whose stockholders own the controlling interest in the company.

The Electro Gas Company not only controls all patents in the Wilson process, but has absorbed all the available patents covering not only the manufacture of crystalline calcium carbide, but the use, also, of acetylene in almost every form, even to bringing carbide in contact with water for the making of acetylene gas and the burning of the gas in a burner.

The best legal talent obtainable has passed favorably upon the validity and strength of these patents, and, what is equally important, the Electro Gas Company has ample funds for offensive and defensive purposes. It is, therefore, probable that the Electro Gas Company will control the sale and use of calcium carbide in this country.

When acetylene was first brought out, it was thought by enthusiastic supporters that it would revolutionize the lighting field. This has not been the case. Liquefied acetylene has been the cause of almost all accidents due to acetylene explosions, and the impracticability of handling acetylene in that form, coupled with the fact that the insurance companies of the country refuse to indorse the use of liquefied acetylene in any shape, has and will prevent its use.

Carbide today is too expensive to displace the larger lighting plants with acetylene. Where a good gas or electric light service is given at reasonable rates, the existing plant will not be affected by competition with acetylene.

Electricity and gas now cover two-fifths and kerosene oil and gasoline three-fifths of the total lighting field.

The sale of the devices now on the market for lighting with acetylene and the use of carbide at present prices have already demonstrated that acetylene is destined to replace two-thirds of the lighting now done with oil, and encroach to the extent of probably one-third upon the existing electric and gas lighting field.

In the smaller towns of 3,000 population and less, acetylene will soon replace existing lighting plants, especially where the present plant is too small or unprofitable to give a decent lighting service. The smallest electric-lighting plant that it would pay to erect costs about $8,000. An acetylene plant, giving a better lighting service, can be built for $4,000 and maintained at a less expense.

The coming year will see, perhaps, two hundred acetylene central stations or plants, with a capacity ranging from 300 to 1,000 lights each, the gas being sold through meter at the rate of from 1½ to 2 cents per cubic foot. This is equivalent to an electric-light rate of 7 to 10 cents per 1,000 watts.

Carbide averages five cubic feet of acetylene to the pound, and the plant will require the services of one man for two hours per day, so it can readily be seen that a plant of less than 1,000 lights can be operated and maintained for much less than electric-lighting plants of the same capacity.

Taking into consideration, then, the first amount of the investment, it follows that acetylene will supersede the very small electric-lighting plants in a great many cases.

Carbide cannot be profitably manufactured except under exacting conditions—a 5,000 horse-power equipment is probably the smallest plant it would pay to operate. The ordinary electric-lighting apparatus is not adapted to its manufacture, so that the utilization of the day load of such a plant is impracticable.

Power is but one of the factors in making carbide. A pure coke is required; a quality of lime showing less than three per cent of magnesia, and favorable freight rates and shipping facilities are equally important. A combination of these requisites is found in but few places in the United States, and it is safe to say there are not half a dozen points in the country that are available for the manufacture of carbide.

That a profit is made in selling carbide at present prices seems reasonably certain, as the Union Carbide Company, whose stockholders are almost all conservative gas men, prominent in the control of some of the largest gas works in the country, would hardly offer their product at the price now asked. That the existing price will not be raised is a simple business proposition. If it was raised to any extent, acetylene gas in the economy of its use would not compete with other illuminants, and its employment would be restricted to an output too small to pay to manufacture.

As the cost of carbide depends particularly on the output of the works, it is inevitable that increased production will lessen the price. Assuming even that it requires an amount of $100,000 or more to build carbide works of a capacity to profitably manufacture the product, and that the patents of the Electro Gas Company are likely to be held good, the

growing demand and prospective profits of the sale of carbide will attract and tempt investment of ample capital to throw down the gauntlet to the Union Carbide Company, unless that company controls the manufacture and sale of carbide through making and selling it at competitive prices, on lines similar to those followed by the Standard Oil Company.

We can, therefore, safely predict that acetylene will be a competitor to electric lighting, of constantly growing importance. We know that last night in the State of Wisconsin, for instance, over seven hundred stores and houses were lighted with acetylene from isolated generators installed during the past year. In fact, the present development of acetylene is almost confined to the Middle States, although a considerable business in acetylene generators is done along the Pacific coast and a comparatively small amount in the Eastern and New England States. The main cause of this uneven development lies with the attitude shown by the different insurance boards of America in classifying acetylene as a fire hazard.

The Western Union of Fire Underwriters and the Chicago Underwriters' Association have granted permits under certain rules for the installation of acetylene generators within buildings, when the construction and operation of the generator has been tested and properly approved. Thirty-two different makes of acetylene generators have been passed upon by these two insurance boards, and permits granted for the installation, inside of buildings, of the generators approved, upon application to any of the insurance companies represented. The first generator passed upon was approved eighteen months ago. It is but three months since the Pacific Association began to issue permits, while the Southern Tariff Association only accepted acetylene business within the past month.

Rules for the placing of acetylene generators were formulated by the Eastern and New England Insurance boards two years ago, and while considerably altered and modified, are not as liberal nor as helpful to the growth of the acetylene business as those adopted by the Western Union of Underwriters. However, it is a question of less than a year's time when all insurance bodies of this country will accept acetylene as a risk under some set of rules governing the installation and operation of the plant. This will be a natural result arising from the fact that there has not yet been any large fire loss caused by acetylene, even though imperfect devices and the carelessness which accompanies the inexperience in handling a new gas have offered its full quota of fire hazards, and also from the reports of fire causes recorded by the Western Union, which shows a surprisingly small per cent of blazes arising from acetylene gas.

Just as the acetylene bicycle lamp is far from being satisfactory, a practical and perfect acetylene burner for cooking and heating has not yet been placed on the market, but there are a few good economical and satisfactory acetylene generators that will give a lighting service destined to replace the small electric lighting plants as surely as kerosene displaced tallow dips.

HOW TO BE KNOWN.

A party who has been continuously advertising more than thirty years said to me recently: "I advertise to be *known* — to *keep* known. I employ salesmen to sell my goods. I do not want my representatives to enter a factory in California or Illinois, and on presenting his card be met with the query: 'I never heard of your house; how long have you been in business?' We recognize that publicity is capital, and we spend thousands of dollars to keep our house before the public, and our salesmen have a great advantage over rivals who do not see the value of publicity." — *Carriage Monthly, Philadelphia.*

THE escape of electricity from a street railway to the injury of a horse on the street is held, in Trenton Pass. R. Co. *vs.* Cooper (N. J.), 38 L. R. A. 637, to be presumptive proof of negligence in the operation of the railway.

IT isn't the man who knows the most, but the man who knows the best that's wisest.

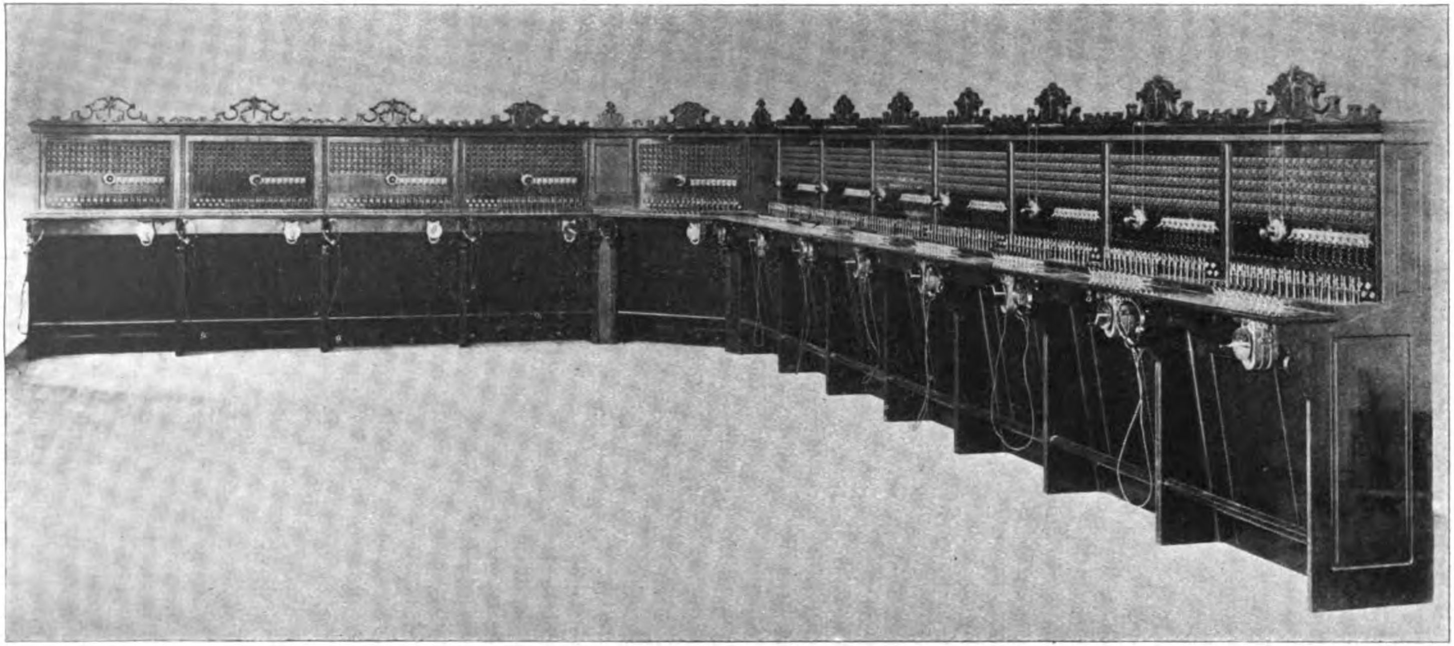


FIG. 1.—AMERICAN NEW TYPE EXPRESS SWITCHBOARD.
Capacity 1,200 Metallic Lines.
Installed for Home Telephone Company, Trenton, New Jersey.

THE AMERICAN NEW TYPE EXPRESS SWITCHBOARD.

Among the several forms of switchboards and exchange apparatus in general that have recently been placed upon the market, the new express board, as now manufactured by the American Electric Telephone Company, represents what can safely be called the highest development in telephone engineering. In it have been combined all the valuable features, which years of practical experience and an accurate knowledge of the requirements for rapid and reliable service have taught the designers to be necessary or desirable. One of the

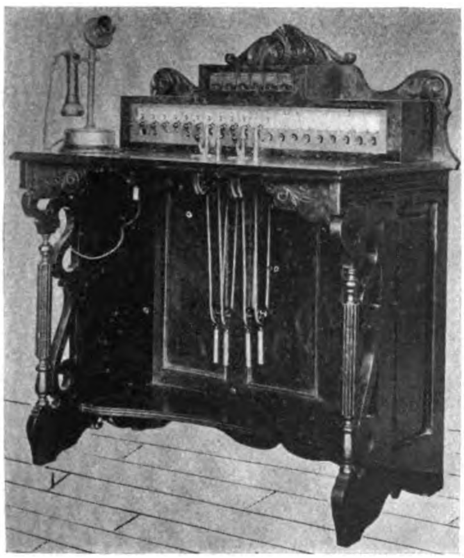


FIG. 2.

largest and most elaborate of the boards has just been completed by the company, and is now being installed in the exchange of the Home Telephone Company, at Trenton, New Jersey. Our illustration (Fig. 1) shows a general view of the board as placed in the commodious operating room, and gives an excellent idea of its size, and at the same time of its compactness.

It is built of twelve standard sections, of 100 drops each, giving a total capacity of 1,200 metallic lines.

The numerous points of superiority entering into the constructive details of the American company's apparatus are well known and have been repeatedly described, so that further mention of them would seem to be superfluous. As usual, the workmanship and mechanical finish is of the highest, the woodwork being solid mahogany with a piano finish.

The monitor board, or chief operator's set, furnished with this installation, is shown in Fig. 2, and is about as neat and handsome a piece of work as ever left the company's shops. It has the usual equipment, consisting of a listening key for each 100 drops, also a small signal lamp for each section, to indicate whether calls are answered promptly or not. The falling of any drop shutter causes these lamps to light, current being furnished by a storage battery, the lamps requiring four volts, and being of 1 candle-power.

A No. 40 desk set and a set of six express drops and connections enable the chief operator to communicate with the heads of the different departments, and to call up any line desired.

FARMERS' TELEPHONE EXCHANGES.

Up in Michigan the farmers are fast taking advantage of the benefits offered by the telephone, and it will be but a short time when telephones will be as common in the country as they are now in the cities. In Allegan County the farmers have an exchange of their own, and maintain it by annual assessment. In Oceana County every township has telephone connection with Hart, the county seat, and this system is essentially a farmers' exchange, being owned and maintained chiefly by the farmers and fruit growers. Gratiot County has another farmers' exchange, which, with Ithaca as the center, has connections with every township and many farmers.

A PHOTOGRAPH tells a tale that cannot be controverted. It neither embellishes nor detracts, and usually it contains pictures of surroundings which are of great value to the reader, and which in the very nature of things must be omitted in a wood cut or a drawing.—*Agricultural Advertising.*

From Harper's Weekly.

THE TELEPHONE IN THE FIELD—AMERICAN TELEPHONES IN USE BY SHAFTER'S ARMY.

From copyrighted photograph by Harper's Special Artist.

THE TELEPHONE IN THE FIELD.

That the Government, during the war, would not be slow in making use of the latest developments in electrical and other sciences is self-evident. Especially was this true of the United States signal corps, which found at its command new devices and appliances that were of immense value in giving quick and efficient service. The American Electric Telephone Company, of Chicago, received several large orders from the War Department for its telephone apparatus, and as the requisitions always were marked "rush," the designing of special, compact apparatus for the field was, of course, out of the question. The company's regular apparatus seems to have done good service, however, judging from our illustration, which shows a No. 30 American Long Distance wall set tied to a tree, an officer of the signal service giving perhaps important information direct to General Shafter's headquarters.

THE BADT HERMETIC CELL FOR TELEPHONE USE.

Nowhere in the application of primary batteries has the need for a perfect cell been so apparent and so keenly felt as in the operation of telephones, whether in the exchange, at the subscriber's station, or in maintaining private lines. The Badt Hermetic Cell, which recently has been brought to the attention of telephone users, is an air-tight open-circuit cell with oil seal and with oil insulation. A careful inspection of its construction cannot fail to create the impression that in it probably all of the defects inherent in so many of the older types have been eliminated.

As shown by Fig. 1, the jar is of the usual shape, but has a channel or trough surrounding the upper edge. This trough is filled with oil, and in it rests the inner rim or flange of the cover, Fig. 2, which has two flanges, the outer one surrounding the top of the jar, thereby preventing dust from getting into the oil trough.

There are three notches at the lower edge of the inner flange to prevent the displacement of the oil in the trough by either internal or external pressure due to the electro-chemical action in the cell.

Each electrode (zinc and carbon), has a shoulder carrying a metal terminal which passes through a hole of the cover, and soft rubber washers are placed on these terminals below and above the glass, in order to make the holes air-tight.

The metal terminals of both the zinc and the carbon are threaded; when

FIG. 1.
Jar without Cover.

FIG. 2.
Cover and Electrodes of Cell No. 1.

the electrode with one rubber washer on the terminal is passed from below through one of the two holes in the cover, the second rubber washer is put on top, a zinc washer next, and then a hexagonal nut is screwed down tightly, compressing the rubber washers on both sides of the hole; then another zinc washer is put on the terminal, and finally the winged binding nut is screwed on.

To sum up, the manufacturers claim as the advantageous points of the cell:

No evaporation.
No creeping of salts.
No leakage of electricity.
No premature disintegration of zincs.
No trouble of any kind.
No attention.
No attendance.
No repair bills.

The Danger of Error.

Never judge a person by his outside appearance. A shabby old coat may enwrap a newspaper publisher, while a man wearing a high plug hat and sporting a gold-headed cane may be a delinquent subscriber.—*Newspaperdom.*

RECENT PUBLICATIONS.

"In the type-case of the printer, all the wisdom of the world is contained, which has been or ever can be discovered. It is only requisite to know how the letters are to be arranged. So, also, in the hundreds of books and pamphlets which are every year published about ether, the structure of atoms, the theory of perception, as well as on the nature of the asthenic fever and carcinoma, all the most refined shades of possible hypotheses are exhausted, and among these there must necessarily be many fragments of the correct theory. But who knows how to find them?

"I insist upon this in order to make clear to you that all this literature, of untried and unconfirmed hypotheses, has no value in the progress of science. On the contrary, the few sound ideas which they may contain are concealed by the rubbish of the rest; and one who wants to publish something really new — FACTS — sees himself open to the danger of countless claims of priority, unless he is prepared to waste time and power in reading beforehand a quantity of absolutely useless books, and to destroy his readers' patience by a multitude of useless quotations."—HELMHOLTZ.

ANGEWANDTE ELEKTROCHEMIE. Dritter Band. Organische Elektrochemie. Von Dr. Franz Peters. Wien, Pest, Leipzig. A. Hartleben's Verlag. 206 pages, 5 by 7½; 5 illustrations. Paper, uncut; price, 3 mark.

The last part of this remarkable work on electro-chemistry follows in arrangement the same course as taken in the first two parts, which were discussed previously in these columns. This last part is divided into three chapters, treating subjects which have found considerable application in practice. In the first chapter on fats, the author gives an account of the various methods used for rectification of alcohols, and the ageing of wines, also of the cleaning and bleaching of fats by electricity. The applications of electricity to beet sugar manufacture and bleaching of cellulose come also under this heading. The experiments made to apply electricity to the manufacture of dyes (aniline dyes in particular) are recorded in the second chapter, while the third chapter starts out with the practical application of electrolysis in dye houses. Considerable space is devoted to tanning by electricity, and finally electro-agriculture finds a place; the Hatch experimental station in Amherst, Massachusetts, being mentioned as an example. This whole work on electro-chemistry is a great labor-saving device for any chemical, and especially for an electro-chemical, laboratory, and deserves the highest commendation.

CHAUNCEY S. HELLICK.

MIT SCHLÄGEL UND EISEN. Eine Schilderung des Bergbaues und Seiner Technischen Hilfsmittel. Von Dr. Wilhelm Bersch. Wien, Pest, Leipzig. A. Hartleben's Verlag, 1898. 800 pages, 7 by 9; 370 illustrations, 26 full-page cuts. Paper, uncut; price, 12.50 mark.

The Hartlebens are known as publishers of popular literature. With the work before us they enter the mining field, and do it in such a way that success must be theirs. The material given is excellent in arrangement and selection; the words of the writer must necessarily appeal to any reader by their clearness and ease of expression.

First of all, the purpose of the work is not to give a book of instruction to the mining engineer, but to enlighten the public in general upon the vast industry of mining, and as the miner belongs to this great mass, the public, to further his personal welfare by picturing to him the history and evolution of his chosen profession in such a manner that he can work more intelligently and thereby improve his situation. With this end in view the author, besides giving an account of the actual mining process, accompanies the mined products upon their journey into the wide world. He furthermore lends his pen not only to the mining of metals that are of the greatest importance in the world's commerce, as iron, coal, gold and copper, but the mining of gems and other useful stones, the production of amber, etc., have also found a well-deserved place.

Thus the work excels in quality as well as in quantity. The introduction emphasizes the relation geology bears to the welfare of the nations; the author takes the reader back to prehistoric times and exhumes before his eyes the witnesses of culture in its infancy. In a chapter entitled "The Earth," philosophical and physical doctrines of the generation of and the changes in our globe form interesting and instructive reading. It is a wonderful achievement of geology to establish a history of flora and fauna out of the formations of the crust of our mother earth.

Words and illustrations compete in picturing the wonders of the antediluvian era. When finally the human being enters the arena he finds dangers staring him in the face from the elements, and most of all from the animals that are his sole companions. He must arm himself against them; but where to find material for his arms? He first takes stone, soon he discovers iron and bronze; there is the origin of mining. The first mining

was extremely crude, so were the first tools; as time and culture progressed, the mining did not stay behind. Time came when it became so important that people devoted their whole life exclusively to it. The peculiar calling of the miner, necessitating the spending of his days below the surface of the earth and far away from civilization in wild mountain ranges, caused the superstitious brains of the middle ages to invent stories of witchcraft and to enliven the mountain forests and passes with brownies and mountain hosts, that shaped the fate and fortune of the miners and their mines. The author succeeded well in joining the romantic with the practical; the work would lose much of its character had he omitted the traditions of folklore.

With modern times, modern ways and modern tools appear. We see the engineer with his instruments and calculations; we see steam and electricity lend a hand to the miner, rendering his labor less exertive, less dangerous and more remunerative. But alas, modern environments have changed the characteristic of the miner. The quaint old figures, clothed in leather costumes on week days and in velvet on holidays, have disappeared from Central Europe, where they had their foothold, also their paraphernalia; today everything is prose.

Now in the pages which follow we encounter the prairie schooner on its journey to the gold fields of California, and the nomadic gold hunter in the Klondike as well as the settled iron and coal miner.

The author leads us through countries far and near, to the north and to the south, to the east and to the west. There is not metal that has not been mined. The salt that humors our palate, the gem that adorns our lady's hand, the stone that shelters us, is just as important to the miner as iron and coal, the kings of modern industry.

The most severe critic must acknowledge that the author has created an excellent panorama of the mining world and the figures moving in it. The sketch artist has been at his best when drawing the magnificent frontispieces to the different chapters; the entire mechanical execution is faultless. Only the foreigner is put out of ease by the Gothic type. Probably the publisher had the conservative German in mind, and "die gute alte Zeit."

CHAUNCEY S. HELLICK.

DER EISENROST, SEINE BILDUNG, GEFAHREN UND VERHÜTUNG UNDER BESONDERER BERÜCKSICHTIGUNG DER VERWENDUNG DES EISENS ALS BAU UND CONSTRUCTIONS MATERIAL. Von Louis Edgar Andés. Wien, Pest, Leipzig. A. Hartleben's Verlag. 292 pages, 5 by 7; 62 illustrations. Paper, uncut; price, 5 mark.

This volume of the technical chemistry series should prove more valuable in this country than anywhere else, for it is in our big cities where skyscrapers carry their huge steel frames heavenward, and where elevated roads are built entirely of iron in contrast to the stone arches used in continental Europe, where the eye and ear are more æsthetic. The author certainly has made an exhaustive study of the causes and effects of rust and of the means to prevent its formation. He critically reviews the many points that have been used to that effect, and not only advises, but also warns. His work is thoroughly up-to-date, taking into account, among other causes, those of electrolytic action. We find also some space devoted to the manufacture of rust-preventing paints. As carelessness and closeness have on many occasions been the cause of allowing iron structures to become covered with rust, it is not out of place to point out ways and means to remedy as much as can be remedied, and the author does not neglect this side of the question. He gives mechanical methods as well as those that are based upon chemical actions. In short, we find in this volume everything pertaining to the rust question collected in such a painstaking manner as has never been done before, or if it has, it is not on record.

C. E. K.

PERSONAL.

MR. F. R. MARSH, the well-known telephone engineer, passed through Chicago last week, stopping a few days to complete the details of some important construction contracts.

MR. CHAS. A. MEEKER, of the Interstate Telephone Company, St. Joseph, Missouri, was among the Chicago visitors recently. Mr. Meeker during his stay took occasion to inspect some of the latest devices of the several telephone manufacturers. Chicago long ago became the Mecca of all exchange managers who contemplate the building of new or improvement of old exchanges.

INDEPENDENT ITEMS.

SHARON, CONN.—The Sharon Telephone Company has filed notice of an increase of capital stock with the Secretary of State. The increase is from $3,000 to $6,000.

MONTEZUMA, GA.—J. Felton and Mrs. C. H. Maxwell have incorporated the Montezuma Telephone Company, with a capital stock of $1,000, for the construction of a telephone exchange.

BRYAN, OHIO.—A new exchange, known as the Bryan Telephone Exchange, has been organized with 150 subscribers. The old company, the Central, has joined forces with the new one and added its eighty subscribers to it.

NEWTON, KAN.—The Newton Telephone Company, A. R. Champlin, manager, will build a long-distance line from Newton to Moundridge. This will give Newton connection with Salina, as a line extends already from Moundridge to that town.

TIFFIN, OHIO.—The Home Telephone Company recently had to install another 100-line switchboard to meet the constantly increasing demand for telephone service. This gives a capacity of 600 lines, with 512 subscribers connected at present.

MANSFIELD, OHIO.—The Farmers' Coöperative Telephone Company has been incorporated by H. T. Manner, N. F. Mowery, W. W. Darling and others. The object is to build and operate a telephone line in Ashland, Richland, Holmes, Wayne and some thirteen other counties.

MANKATO, MINN.—Mr. H. M. Kellogg has been awarded the contract for installing a 200-line exchange in this city for $7,500. The exchange is to be supplied with 200 Stromberg-Carlson 'phones, with metallic trunk switchboard containing 200 drops, but wired for 300, and all other equipment necessary to make a first-class exchange in every respect. In the business district of the city the poles are to be sixty feet long, carrying the wires above everything in the city, thus avoiding the danger of other wires falling on them. The plant is to be entirely completed within ninety days.

STAUNTON, VA.—The third business year of the Staunton Mutual Telephone Company closed on the 10th of last month, showing a very prosperous condition of affairs. The company now has over four hundred subscribers in Staunton, and connection with over 2,000 'phones in the county and adjoining towns.

CHARLESTON, W. VA.—The Secretary of State has issued a charter to the New Rochelle Telephone Company, of New Rochelle, New York, for the purpose of carrying on the business of dealing in telephones, telephone devices, apparatus, appliances, materials and supplies. Capital subscribed, $100, with the privilege of increasing the same to $500,000. The shares are $10 each and are held by George W. Sutton, of New Rochelle; A. R. Hopkins, of Montclair, N. J.; H. A. Conner, of Brooklyn, N. Y., and others.

DES MOINES, IOWA.—The completion of the new 2,000-line switchboard being installed by the Sterling Electric Company, of Chicago, for the Des Moines Mutual Telephone Company will mark the beginning of greatly improved local service in that city. Provision has been made for extending its capacity to 3,000 lines should it be found necessary. One of the strong points of the board is the provision it affords for changing to metallic circuits. The success of the Mutual Company from its start, less than a year ago, has been more than gratifying. Beginning with 500 'phones in use on October 1, 1897, the business has steadily increased, so that by the first of next month over 1,200 subscribers will be served.

RIPLEY, N. Y.—S. Fred Nixon and others have incorporated the Ripley Telephone Company. The capital stock is $13,000.

COLUMBUS, OHIO.—The Quaker City Telephone Company has been incorporated, with a capital stock of $500. The incorporators are J. W. Hill, H. S. Hartley and others.

WOODLAND, CAL.—A franchise and right of way to construct and operate a telephone line between Rumsey and Woodland has been granted to the Capay Valley Telephone Company.

OMAHA, NEB.—The Trans-Mississippi Telephone Company has been incorporated, with a capital stock of $10,000. The incorporators are William B. Douglas, W. P. Carlisle and W. P. Lathrop.

CARLISLE, PA.—A new telephone company, under the name of the Southern Telephone Company, will operate lines of telephone and telegraph in Cumberland, Adams and Dauphin counties. M. P. Thompson and Walter Stuart are interested.

NEW ROCHELLE, N. Y.—With the coming of the Phœnix Telephone Company in this city, the people will enjoy the benefits of low rates, which the old company would never concede unless forced by competition. The Phœnix Company promises first-class service.

CENTRAL, S. C.—The Central-Liberty Telephone Company has been incorporated, with T. N. Hunter president and general manager and H. L. Clayton secretary and treasurer, for the purpose of constructing a telephone system from Central to Liberty, in Pickens County.

MEDINA, OHIO.—The Medina Telephone Company has obtained a franchise to operate an independent telephone exchange in this place. Construction work will begin as soon as a sufficient number of subscribers are secured. The indications for liberal support are very favorable.

MONONGAHELA, PA.—The Maryland, West Virginia and Pennsylvania Telephone Company is competing with the Bell Telephone Company in the Monongahela Valley. The former company has exchanges at Uniontown and Connellsville, and is putting in an exchange at Masontown.

PONTIAC, ILL.—The Livingston Telephone Company has been entirely reorganized. W. L. Rupert has been elected president, A. M. Legg, secretary, and J. S. Murphy, treasurer. Under the new management the exchange will equal in efficiency of service any in the State.

CHARLESTON, S. C.—The Home Telephone Company is moving ahead. Organization has been completed, and it will commence work at an early date. It has 200 to 300 subscribers, who bind themselves to take Home 'phones five years to the exclusion of the Bell 'phones. The company expects to begin with its service by the first of the year.

QUINCY, ILL.—G. L. Thompson, J. Padgett and others have incorporated the Siloam Springs Telephone Company, with a capital stock of $1,500, all paid up. The purpose of the company is to purchase, maintain and operate a telephone line connecting Clayton, Siloam Springs, Kellerville, Barnard, Libertyville and other places in Illinois.

CHARLESTON, W. VA.—The Warren Telephone & Telegraph Company, Warren, Pennsylvania; capital subscribed, $500; amount paid in, $50; amount authorized, $25,000; and the Union Telephone & Telegraph Company, Erie, Pennsylvania; capital subscribed, $500; amount paid in, $50; amount authorized, $1,000,000, have been incorporated.

FORT DODGE, IOWA.—The organization of the Fort Dodge Telephone Company has been perfected and the following officers elected: President, E. F. Seymour; secretary, R. O. Green; treasurer, G. C. Kettering. The company will now proceed at once with the erection of their plant and the completion of the details of their business. They will have, when ready to open their exchange, one of the best equipped plants in the State. The work of putting in the plant will be pushed forward at once, and its completion will soon follow.

TRADE NOTES.

MANAGER T. S. LANE, of the Electrical Exchange, says he finds no cause to complain of any delay in the coming of prosperity, when orders for machinery to the amount of some $3,000 keep coming in every week or so.

THE Cutler-Hammer Rheostat Company, Chicago, is enjoying one of the most prosperous periods of its existence. Some time ago it was found necessary to largely increase the manufacturing facilities, so another floor of the building was secured and equipped with a liberal assortment of machinery and fittings. The results were almost immediate, August showing a gain in the business of over thirty per cent as compared with any previous month.

THE Farr Telephone and Construction Supply Company's sixth edition of its interesting catalogue is off the press, and being distributed among the company's large list of old and new customers. The name "catalogue," however, is not a very appropriate one, for the book has long ago become a handbook of practical information for the telephone user. It contains hints to telephone men; how to build telephone lines; diagrams and directions for connecting telephones; how to overcome telephone troubles; diagrams for connecting intercommunicating systems; weight and resistance of line wires; estimating for building exchanges; induction of various wires; about telephone patents; diagrams of different methods of line connections; and other valuable points. Over two hundred illustrations show everything needed in telephone work. This valuable book is sent free on request.

NOTICE.

Subscribers who do not file their copies can have their subscription extended three months for each copy of No. 83 of the TELEPHONE MAGAZINE, mailed to

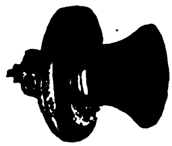
ELECTRICAL ENGINEERING PUBLISHING CO.

CHICAGO.

Electrical Engineering
And Telephone Magazine

CONTENTS OF THIS NUMBER.

Facsimile of Diploma with Bronze Medal awarded ELECTRICAL ENGINEERING for Specimens of Printing and Bookmaking, Brussels International Exposition, 1897.



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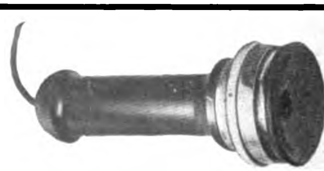

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☞ This Company owns Letters-Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined telegraph and telephone, covering all forms of microphone transmitters or contact telephones.

Electrical Engineering
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THE USE OF ELECTRICITY IN THE SPANISH-AMERICAN WAR.*

BY THOS. G. GRIER.

The application of electricity in the Army and Navy for its various and many purposes is recent, but its progress is rapid. The object of this paper is more to note the uses than to describe the details.

The fortification board established ten years ago by the United States Government has developed complete and elaborate plans for the equipment of coast fortifications.

In these plans electricity plays a very important part. Submarine mines connected by cable with harbor forts have been planted, electric light and power stations have been installed, search lights, motors, telephones, telegraph instruments and many other devices have been used in preparing for the defense of our harbors.

Range finders for determining distances were extensively used; these instruments may be dependent upon electricity for their operation, as in the case of the Fiske range finder, or may be operated mechanically.

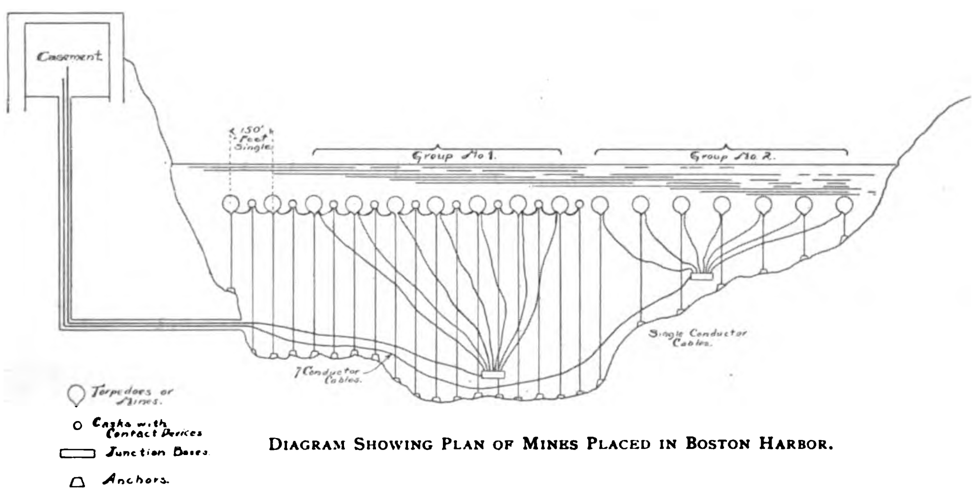


DIAGRAM SHOWING PLAN OF MINES PLACED IN BOSTON HARBOR.

Just prior to our recent war with Spain 200 Lewis depression range finders were ordered by the United States Government to equip our various fortifications. While these instruments are operated mechanically their efficiency in action depends upon the application of electricity in communicating the distance observed to the gun captain or commander.

To condense as much as possible, a

* Read before Chicago Electrical Association, October 7, 1898.

brief summary of the applications can be given by describing the methods employed at Fort Wadsworth, which lies just below New York City. In this fort the fire commander directs the attack from a sheltered station equipped with a Lewis range finder. There are also a position-finder station and four battery commander stations. The fire commander is in direct communication with all by means of telephones.

In the position finder's station, together with numerous other instruments, is a dial telegraph, electric clock and telephone. One of the guns is equipped with a dial telegraph and another with a Sheey teleotype, an instrument which indicates the azimuth or angle from a predetermined line and gives the range or distance in yards the observed vessel is from the fort.

All of the commanders' stations are, however, connected with the guns both by speaking tubes and telephones.

Observations are signaled to the guns, and the course and speed of a ship are plotted upon a miniature representation of the harbor. By means of an electric clock placed at every station absolute uniformity of time is obtained, and the probable course and range of a vessel for several minutes can be plotted from these observations, and without even seeing the vessel the gun can be elevated for the range and trained for the proper angle, and by means of a stop watch the order to fire given so that the shot will fall upon the deck of a vessel whose course has been observed by men at a distance from the guns. The introduction of electricity for signaling has given this wonderful control to the fire commander over his batteries.

Sandy Hook, at the mouth of the harbor, is connected by cable with Fort Wadsworth, and the approach of hostile ships may be telegraphed to the fire commander so that their course may be watched and the fort prepared at the proper time to do justice to the work before them.

Sandy Hook was placed in telephone communication also with Washington during this summer, so that the Government was in position to receive or send messages to the fortifications.

Fort Wadsworth has two 60,000-candle-power search lights to sweep the harbor and guard against the approach of vessels on dark and stormy nights.

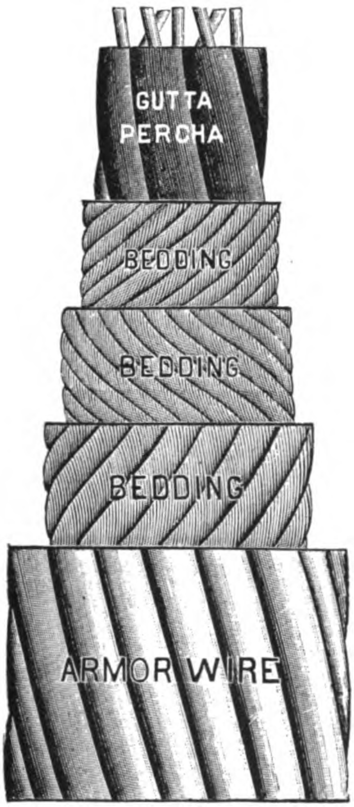
An electric light and power plant forms a portion of the outfit with a reserve storage battery to supplement the power station.

The channel above the fort is mined, and should some of the vessels of a hostile fleet pass the guns of the fort, the observer at the submarine station would be plotting the course of nearby ships, by means of range finders or by information furnished them by the fort, and at the proper time fire the mine and sink the remnant of the fleet.

The mining of the harbors was an important part of our coast defenses, and the greatest demand for electrical wires and cables was for "torpedo cables" for use in submarine mines. It seems that our coast defense department has for years requested that an appropriation be made for cable, but the appropriations have been so cut down that not more than five per cent of the amount needed was carried on hand by the Government. There are two styles of cables used, a multiple cable of seven conductors which is used to connect the shore end to a junction box in the channel, and a single conductor cable which connects each conductor in the multiple cable to an independent mine, each conductor being numbered. Any mine may be exploded at will from the shore.

When war was declared each of the

manufacturers of submarine cable in this country received orders for all they could make in thirty days, and some were kept busy for sixty days, producing, probably, two hundred miles of multiple cable and two hundred miles of the single conductor. This has been distributed from the Bay of Fundy to Florida. Some was sent to the gulf cities and some to California, Oregon and Washington.



SEVEN-CONDUCTOR TORPEDO CABLE.

One hundred and fifty miles of each size was under contract in the early part of August. The cost of seven-conductor cable averages about $1,900 per mile, and the single conductor about $450 per mile.

Headquarters for work on submarine mines are at "Torpedo Station," Willets Point, Tory Island, with Maj. John D. Wright in charge.

In preference to any description of the cables showing the construction, a picture of the seven-conductor cable as made by the Bishop Gutta-Percha Company, of New York, is given, and samples cut from cables shipped to the Government by the Bishop Gutta-Percha Company, of New York, the Anchor Electric Company, of Boston, the Simplex Electrical Company, of Boston, and the Standard Underground Cable Company, of Pittsburg, have been secured.

SUBMARINE MINES.

There are three different kinds of mines used in our harbor defense.

First. Observation mines, which are fired from shore when a ship is judged, by observation, to be within effective range of the explosive.

Second. Automatic mines, which are self-firing on being struck by a vessel.

Third. Electrical contact mines, which, on being struck by a ship, give notice on shore, and the operator, by the throw of a switch, fires the mines.

The method of firing observation mines and electrical contact mines are similar. Automatic mines may or may not be fired by electrical means.

Mines may be placed upon the bottom of the harbor, and in such cases are called ground mines, and if they are contact mines the contact mechanism is contained in small buoys anchored at a depth below low-water mark just sufficient for them to be an obstruction in the path of vessels. When the channel is deep, buoyant or floating mines are used. A buoyant mine is more effective, as it lies nearer the object of attack, and for an equal effect does not require as large a charge of explosive.

MINES IN BOSTON HARBOR.

The shape and material of mines or mine cases are various, and the kinds

employed at different points not always identical. However, a general description of the mines employed in Boston harbor will give a good idea of the plan and design used in all other harbors.

There were about one thousand mines planted in Boston harbor, covering the main ship channel and ingress to the harbor where vessels of over 12-foot draft could go at low water. The regular Government mine consists of an upright iron cylinder about the shape of a top, with a strap on the bottom for holding the cable. Galvanized steel rope secured by an anchorage of any kind, and in many cases of old horse-car rails, maintained the mines in position. The cable containing the electric wires runs up separately from the cable holding down the mines.

As the demand was urgent and no mines of the Government pattern were to be had, the engineers in Boston used new ale barrels, a hole being bored in one end for the receipt of the contact mechanism and cable. The barrels were encircled with rope to make a sling to hold them down, a flat steel ring put around the rope so that the steel anchor cable attached to it would not cut through. These mines were of different sizes and held from 100 to 500 pounds of explosive gelatin. Ordinary dynamite was used in some mines where there was not enough gelatin to be obtained. This was put in through a small hole in the top where the electric contact mechanism is placed.

The contact mechanism is connected through high resistance and by a battery circuit, using the cable and ground return for its conductors to an indicating and circuit-closing device located in the protected casement on shore. When a ship strikes a mine containing the device, deflecting the mine from its normal position, the battery circuit is closed; this operates an indicating mechanism which closes a break in the dynamo circuit and notifies the operator. To throw on the current for exploding a mine it is necessary to throw in a switch or plug after the first break is closed by the indicating device. This circuit can be closed without any contact from the vessel at the will of the officer in the casement.

The firing switchboards at Boston consisted of an ordinary knife switch suitable to take 500 volts, with a spring which holds it out of contact at all times except when kept in position by the operator. These switches, one for every group of mines, were mounted on slate boards and plainly numbered with large letters. A dynamo developing one ampere at 500 volts, driven by an oil engine, furnished the exploding current.

The contact devices were made part by the Anchor Electric Company and part by the General Electric Company, the design being that of the Government with several alterations made by Dr. Louis Bell, the engineer in charge for the Government, to shorten the time of manufacture. All of the parts of the contacting mechanism were of platinum or gold-plated brass to prevent any possibility of corrosion. The exploder consisted of a thin strip of platinum wire which was laid in a case of fulminate, which in turn was put in a case of dry guncotton; the remainder of the explosive was wet.

The mines were usually placed in groups of seven each, about 150 feet apart. These groups of mines in Boston harbor were strung clear across the channel and in the main channel there were three lines.

In this method, should a vessel be sunk by the first line of mines and the wreck not obstruct the passage for other vessels, the second line of mines would catch the next vessel and the third line

the third vessel. Between the mines were small casks with contacting devices connected to mines on either side. These were cheaper than mines but were equally serviceable and made the line complete, so that no vessel could get through.

The submarine cables connecting the world's centers of humanity — a great system of electric nerves — had a most important influence in every feature of this war. Ships at distant points were enabled to advise and receive information, and movement of fleets could be directed from the seats of government. It is hard to conceive of this almost complete annihilation of time and space.

The Oregon, that speedy and modern man-of-war, equipped with powerful machinery, took eighty-one days to make the remarkable voyage from Puget Sound to Key West, a distance of about 18,000 statute miles, and of this time she was about fifty-nine days at sea. The distance by cable and telegraph from Chicago to Hong Kong is nearly as great, yet to send a message between these two points, including all the delays caused in the many transfers, requires less time in minutes than it took the Oregon days to make the trip.

Our army in the field has its cable tents completely equipped with telephones and telegraph instruments. The telephone at Santiago and adjacent points before and after the siege was of great service, and cable tents now have their names lengthened into the title of cable and telephone tents.

The Bishop Gutta-Percha Company, of New York, has furnished the Government with a special cable, which is used in the signal service by General Greeley. It is very light and very strong, weighs about sixty pounds to the mile, and is furnished on reels in half-mile lengths — a two-conductor concentric cable. This outpost cable, as it is called, is carried by a scout on a reel fastened to his back like a knapsack. He carries a telephone, and one end of the cable being connected at headquarters enables him to communicate in whispers to his commander. An attendant accompanies the scout with extra reels, which are easily attached when the wire on the first reel has reached its limit. Telephones, in fact, are used everywhere—in forts, in camps, in the field, and on board vessels.

Among the most recent applications of electricity that found a place in the army and navy was the "X-ray" apparatus. It was used in the field, in the hospitals, and on the hospital ships. The Solace was equipped with the latest production of the Edison Manufacturing Company.

Notices were published in the papers of electric cooking outfits, which were going to be placed upon some of the hospital ships, and if it was done there is no doubt that much comfort and convenience resulted, especially when the vessels were in the warm climate of the West Indies.

Aboard modern men-of-war the electric light is found to be absolutely necessary for the efficiency of the ship. Search lights are used to observe the movements of other vessels, to find buoys or landmarks on entering shallow channels, to pick up disabled boats or men overboard, to make landings, and for signaling. The incandescent lamps illuminate the entire ship, dispensing with oil lamps and candles; they are also used for night signaling.

Electric motors are used in hoisting boats and ammunition, for removing ashes, for steering, for training gun turrets and many other purposes.

Steam whistles are opened and closed by electrically operated valves.

The range for guns and the speed and direction of revolving shafts is determined

by the electric current, and guns are fired by an electric spark.

Telephones and electric signaling devices aboard ship are extensively used.

This, in brief, covers the application of electricity ashore and afloat in the recent Spanish-American war.

A description of the principles governing some of the signaling devices on board ship will materially assist in showing to what a great extent modern vessels depend upon electricity.

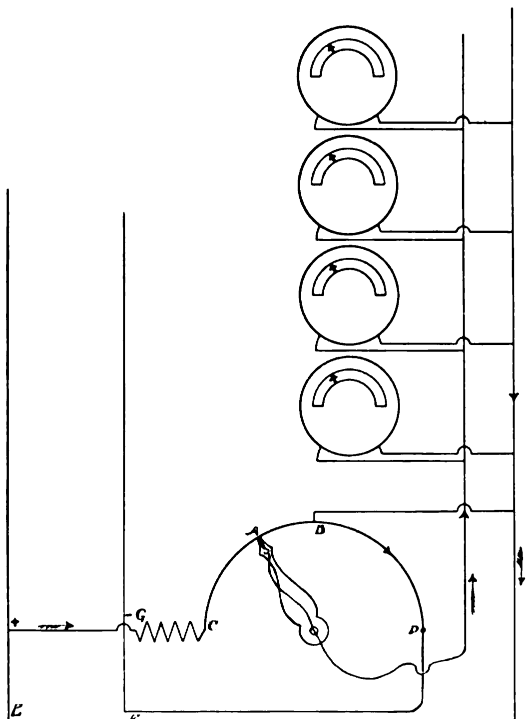


FIG. 1

The signaling and indicating devices used on vessels are: "helm indicators," "steering telegraphers," "speed indicator," "direction indicator," "range indicating system," "Fiske range finder," "azimuth telegraph" and "transmitter of orders." All of the devices consist of galvanometers, which indicate on their dials a difference of pressure, the dials being marked for the different offices the instruments perform, and with each instrument or system of instruments proper devices are used for altering resistances and consequently changing pressures to accomplish the ends in view. A description of the principle applied to the helm indicator will explain the operation in general of all the others.

The object of the helm indicator is to indicate, at different parts of the ship, the position of the helm. The principle of operation is shown in Fig. 1. Attached to the helm and insulated from it is a metallic contact, A, which presses continually on an arc of resistance wire, C D. At the center of this resistance wire is a permanent contact, B, which is connected by a wire to one side of a number of galvanometers located at various stations. E and F are the negative and positive wires of the electric lighting system. Primary or storage batteries also could be used as the source of energy. A dead resistance is inserted in the circuit connected with the arc of resistance wire, C D, which reduces the current to about two amperes.

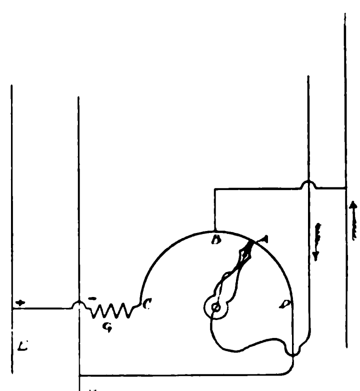


FIG. 2.

The current flows as indicated by the arrows. As the pointer, A, is moved toward the left, or toward C, the difference of pressure A and B becomes

greater and the flow of current through the galvanometer is greater. The galvanometers are adjusted so that they take the same angle as the helm, or pointer A. In Fig. 1, when the pointer is on the left of B, its pressure, as compared with B, is positive. When B and A are both in the center, or when the pointer A coincides with the fixed point of contact B, then the needles of the galvanometers come to rest at zero or the center of the scale. When A is moved toward the right, or toward D, then the conditions are reversed (Fig. 2), A becomes negative compared with B, and the current flows in the opposite direction in the galvanometer, bringing the needle toward the right. One of the instruments can be on the bridge, one in the captain's cabin, one in the wheelhouse and one in the conning tower.

The steering telegraph is the same arrangement of galvanometers, with a device for altering the resistance by hand. The captain sets the resistance from his station, having an instrument before him. The same indication appears upon an instrument in the wheelhouse, and by noting the helm indicator the captain is advised when his order is obeyed. The same thing is true of the engine telegraph, the transmitter for orders and the azimuth telegraph.

In the Fiske range finder the general principle is the measurement of the resistance of a conductor in the form of a Wheatstone bridge, there being two arcs of wire at the ends of a base line, corresponding to two contiguous members of the bridge. Two telescopes are located at the ends of the base line and carry contacts which move over the resistance wire as the telescopes are turned to be pointed upon any object.

In Fig. 3, let the arms *a*, *b*, of a Wheatstone bridge be represented by arc *h* while *c* and *d* are bent into arc *k*, both of

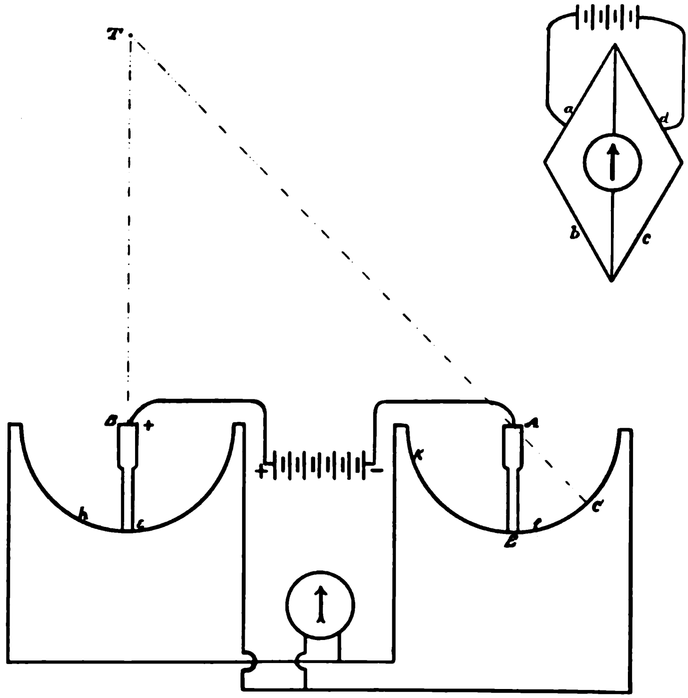


Fig. 3.

these arcs being wires of conducting material. Let contacts *e* and *f* be attached to telescopes pivoted at A and B. When the telescopes are parallel and when at right angles to the base line, the galvanometer will not deflect and its point of rest is marked infinity. Now, let the telescopes converge and the angle of convergence is A T B, and presuming the telescope at B is pointing at right angles to the base line, the angle of convergence is measured by the arc C E,

the bridge is out of balance, that is, the needle deflects, and the amount which it is out of balance will vary with the difference of position of the telescopes. The angles of convergence are not indicated upon the galvanometer, or reading instrument, but the deflection of the needle is marked in yards.

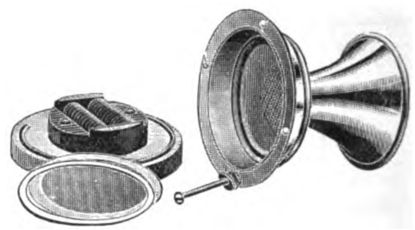
The speed indicator is, in reality, a small alternating-current dynamo; the current being great or small according to the speed of the shaft, and the strength of the current indicating upon an alternating-current galvanometer graduated in revolutions per minute. Six soft iron cores or inductors fastened to an iron ring on the shaft form the armature. These are rotated, the pole of a north and south magnet having two coils of wire at its extremities, the coils of wire being connected in series with the galvanometer.

The direction indicator simply tells in which direction the shaft is turning. A permanent magnet fastened to a ring on the shaft revolves in front of a soft iron bar, around which is a coil of wire that is connected to a galvanometer. The shaft revolving in one direction throws the pointer to one side, and when its direction is reversed throws it to the other side.

THE RUEBEL TELEPHONE TRANSMITTER.

Much time and thought has been spent by inventors in the production of a microphone transmitter that would be free from the many defects and objections met with in the earlier forms. Among the many, who from the earliest days gave considerable study to this interesting part of the telephonic apparatus, was Mr. Ernest Ruebel, of St. Louis.

His many experiments and investigations finally led to the construction of the transmitter illustrated herewith. It is of the most simple form, consisting practically of but three parts aside from the separate carbon disks. A shallow rubber chamber contains two semi-circular carbon base blocks, between which two rows of extremely small carbon disks are arranged, each row insulated from the other by a strip of insulating material. A carbon diaphragm serves as cover to the box, the diaphragm being held in place by the mouthpiece. From each carbon block a screw makes connection with the binding posts on the back. The distance between the disks and the diaphragm



THE RUEBEL TRANSMITTER.

is such that when the latter is in place and the rows of disks are horizontal, they rest rather loosely against the diaphragm, which, of course, completes the circuit. Repeated tests have demonstrated that the transmitter works equally well on short or long lines. In the latter case more battery is, of course, used, up to five or six cells. The apparatus has no granules or dust to pack, cake or settle; on the contrary, constant use rather improves its quality, because the vibrations of the diaphragm cause a slightly rotating motion to be given to the disks. The outer surface of the diaphragm is coated with a waterproof paint, so that the transmitter can be left under water without impairing its usefulness. Nothing but carbon and hard rubber is used in its construction.

PERSONAL.

MR. E. H. WELLS, formerly second vice-president and manager of sales of the Babcock & Wilcox Co., has recently been elected president of that company, filling the vacancy caused by the death of Mr. Bennett, the former president. Mr. Wells' election to this responsible position is a deserved recognition of his efficiency and ability in handling the technical as well as business departments of this large concern.

PARTY LINES.

III.—BY KEMPSTER B. MILLER, M.E.

SELECTIVE SIGNALING—"STEP BY STEP."

We come now to the consideration of selective signaling on party lines, and it will be remembered that systems for accomplishing this result were divided into three distinct classes. The first of these classes, which will form the subject of this article, includes those systems depending on step-by-step mechanisms at the subscribers' stations, controlled from the central station in such a manner as to enable the operator to pick out or select the desired station and ring its bell to the exclusion of all others on the same line. It is well to state beforehand that this branch of party line work will be of interest mainly from a historical standpoint and will therefore be treated in that light. I am not aware of a single line in successful practical operation, using a system of this class; but this should not detract from the interest of the subject, for there is no doubt but that apparatus can be successfully operated on this plan, especially in view of the success of the "ticker" and other systems of telegraphy depending for their operation entirely on step-by-step movements. The use of step-by-step mechanisms in this class of telephone work has apparently from the very first offered the most plausible solution of the problem, and there are seemingly no insurmountable obstacles in the way of its being put into successful practice. Moreover, the fact that the patents on several of the systems to be described in this article have already expired, or will have expired before this article is fairly in print, will be of special interest to the independent telephone people.

One of the very first to apply step-by-step mechanism to the party line problem was E. N. Dickerson, Jr., as early as January, 1879. His substation mechanism is shown in Fig. 1, and the line and local circuits respectively in Figs. 2 and 3. Before describing the apparatus, however, it is interesting to note how clearly Mr. Dickerson, at this early date, had the requirements of party-line signaling in mind, by quoting from the prelimi-

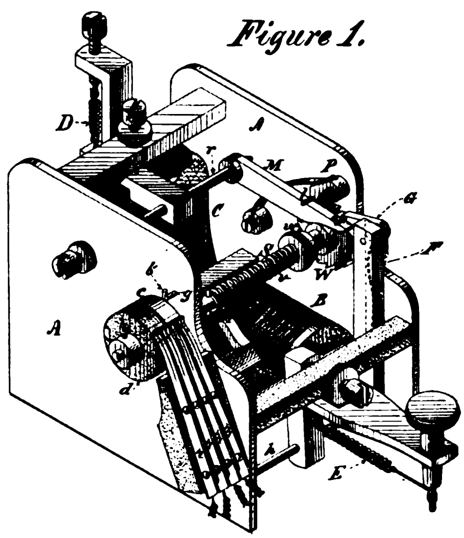


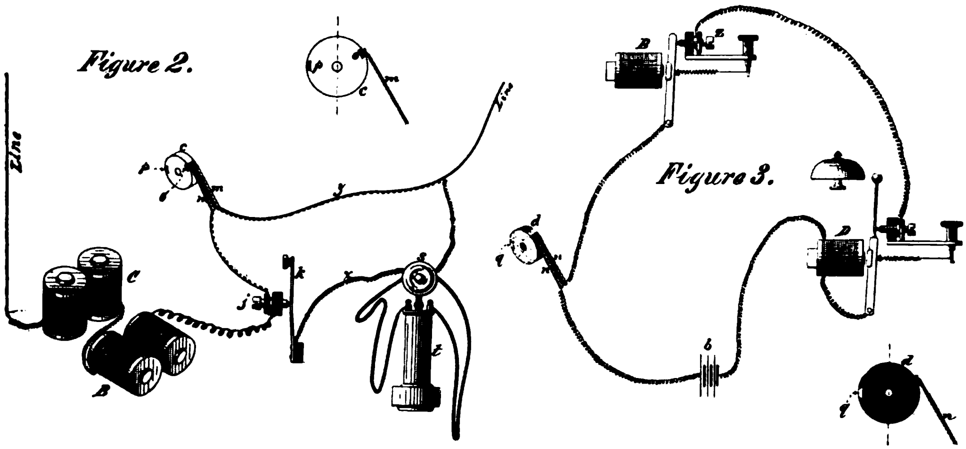
Figure 1.

nary portion of his specification, which reads as follows:

> In the practical operation of . . . . . systems in which a series of instruments is placed upon a wire connecting with a central office, the different instruments of the series being distributed in localities where there are no experienced operators, it is important and desirable to possess an instrument which can be controlled from the main office, and will signal at any one of the line offices without disturbing or signaling any of the others.
>
> The usual and most convenient method of signaling is by means of an electric bell or gong; and one of the objects of my invention is to provide a series of signaling instruments placed upon one wire, and so constructed that

the controlling operator can cause the bell connected with any one of them to sound, while all the other bells will be silent. It is also important that any one of the line offices has the power to signal the central office at any time when the apparatuses are in their normal condition, or at the time when the central office is signaling the office in question, but shall not have the power to interrupt a message or signal passing between the main office and any one of the local offices.

My apparatus also accomplishes this result, and enables a line office to signal the central office in the normal position before movement of any of the apparatuses, and also in that position when communication is maintained with it from the central office.



It is important that no office except the one called from the central office have the power to overhear messages being transmitted between any other offices.

Referring now to Fig. 1, B and C represent two electro-magnets, placed in series in the line circuit. The armature of B is mounted on an arbor *h*, pivoted in the framework as shown. This arbor carries a lever F which is moved by the armature, and by means of a pawl G steps the ratchet wheel W around in an obvious manner. A second pawl P normally acts to prevent a backward movement of the shaft S on which the wheel W is mounted; a tendency to such backward movement being given to the wheel and shaft by the coiled spring *v* mounted on the shaft.

The magnet C, by the attraction of its armature, operates upon the arm M, pivoted with the armature upon the arbor *r*. The raising of this arm lifts both pawls out of engagement with the wheel W, allowing it to be rotated by the spring until the pin *b'* engages the stop pin *g*, when it is in its normal position.

Upon the end of the shaft S are two contact wheels *c* and *d* upon which rest four springs *m m* and *n n*. The periphery of the wheel *c* is all of conducting material with the exception of two insulating strips *o* and *p*, clearly shown in Fig. 2. The wheel *d* is of the reverse construction, all of its surface being of insulating material with the exception of the metallic contact strip *q*, as shown in the small cut in the left-hand portion of Fig. 3. In the normal position of the wheel *c* at each of the stations the springs *m m* rest upon the insulating strip *o*. The insulating strip *p* on the wheel *c* and the conducting strip *q* on the wheel *d* are arranged at different positions on the wheels of each station, and always so that when the particular number of impulses necessary to place the apparatus

at that station in operative relation to the line, the two strips p and q will be respectively under the springs m m and n n.

The apparatus at the central station consists of batteries of three strengths; the weakest capable of operating only a high-resistance magnet at the central station; the next strongest capable of operating the magnets B, but not the magnets C; and the third, or strongest, of sufficient strength to operate the magnets C. In order to make C responsive to the strongest current only, the coiled spring D, which controls its armature, is given a higher tension than the spring E controlling the armature of B. The signal-transmitting apparatus at the central station consists of a toothed wheel or any other device for sending a predetermined number of impulses to the line, from either of the two stronger batteries. Normally, the weakest of the three batteries is left in line.

The normal condition of the line circuit through a station is shown in Fig. 2 where the springs m m rest on the insulating portion of the wheel c, and are therefore disconnected from each other. The receiver t is shunted out of circuit by the automatic hook switch s upon which it hangs. In this condition, therefore, the circuit through the station is from the line through magnets B and C in series, thence through switch k, hook-switch s and to line. The circuit is therefore complete when no one is using the line from ground at central, through the small battery and high-resistance annunciator or bell at that station, then through all the stations in series and to ground at the end station.

To signal central, a party at any station depresses the key k momentarily, thus breaks the circuit and releases the armature of the signaling magnet at central. The party may then communicate with central by removing his telephone from its hook.

In order for the operator at central to call up any station, a number of impulses from the battery of intermediate strength is sent to line. The first one of these impulses advances all of the ratchet wheels one step, and the springs m m therefore rest on the conducting portions of the contact wheels at all except the first station, which has the insulating strip p so arranged as to come under the springs at the first step. As a result the receivers at every station except station No. 1 are short-circuited through the by-path containing the springs m m and the disk c. Suppose the station shown in Fig. 2 to be No. 5, then five impulses will bring the strip p under the springs m m, when the receiver will be no longer short-circuited.

At the same time that the strip p comes under springs m m, the conducting strip q on the other wheel comes under springs n n, thereby completing the local circuit containing a battery b and a vibrating bell D, as clearly shown in Fig. 3.

The local circuit is only closed when the armature of magnet B rests against its back stop Z. This is to prevent the actuation of the bells D at the stations having a smaller number than the station desired, as it is obvious that the springs n n will wipe over the contacts q of all the stations in succession which have a smaller number than the one being called.

While this station is engaged in conversation the other stations are locked out by reason of their receivers being short-circuited. At the end of the conversation the strongest battery is thrown on the line, and the magnet C at each station causes the arm M to lift the pawls P and G, in consequence of which all the ratchets return to their normal position.

While any good telephone man could point out many features in this system of an extremely objectionable nature, such, for instance, as the inclusion of so many magnets in series in the line and the employment of three strengths of battery and a corresponding marginal adjustment of the magnets, the fact that such an ingenious arrangement could be devised at such an early date in the art would seem to bode exceedingly well for future development in this line.

At almost the same date George L. Anders produced a step-by-step system, depending on a somewhat different idea. All bells were left permanently in the line wire, and their hammers all actuated in unison when a pulsating current was sent over the line. A notched disk at each station prevented the bell hammer at its station from striking the bell except at such times as the notch was opposite the rod which carried the hammer. The disks were so arranged as to be stepped around by the vibrations of the bell hammers while impulses of one polarity were sent over the line. In calling a certain party a sufficient number of impulses were sent to bring the notch of the bell at the desired station into a position opposite the bell hammer rod, after which currents of the opposite polarity were sent over the line. These latter did not actuate the stepping device, but did actuate all the bell hammers as before, and the notch in the disk of the desired station allowed that bell to sound.

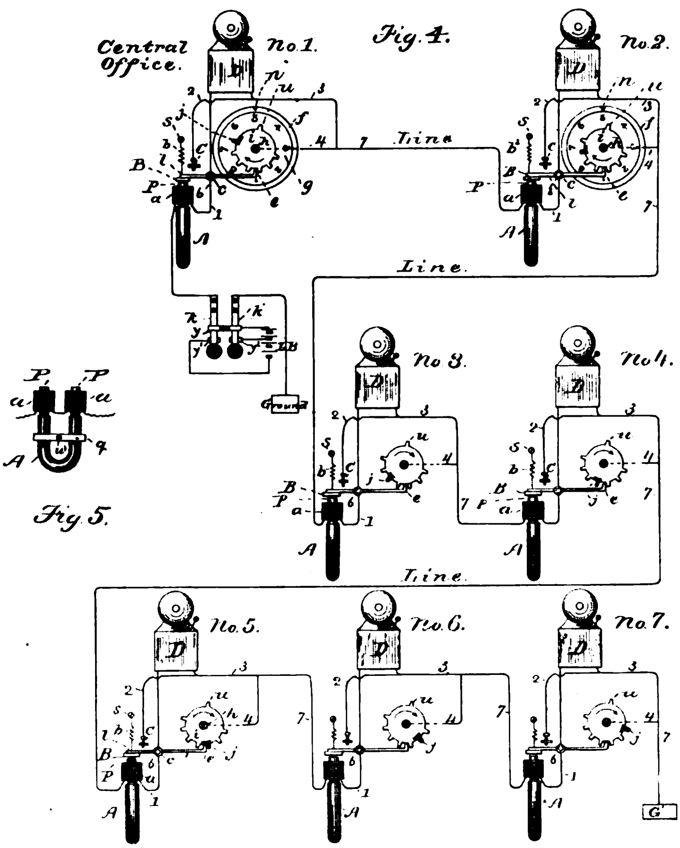


Fig. 4.

Fig. 5.

Dickerson used his stepping device to control a local circuit at each station. Anders left all his circuits unaltered and used his stepping device to control merely the length of stroke ot the bell hammer.

Still another interesting example of the early art in this line is the system of Thomas D. Lockwood, designed early in 1881, which is well illustrated in Figs. 4 and 5. In this the toothed wheels *i* shown at the different substations are all adapted to be revolved by clockwork at exactly the same rate, so that when they are all released at once they will move with the same angular velocity until

stopped. Each wheel is furnished with square teeth, corresponding in number to the stations on the circuit. These are placed at a suitable distance apart on the periphery, and in each case one tooth *j* of the series is composed of nonconducting material, which is inserted into the metal portion of the wheel. This nonconducting tooth *j* is, of course, differently placed at each station in the circuit, as shown in the drawings, where the central office wheel has its insulating tooth placed as the first tooth of the series. In station No. 2 it is the second tooth, and so on. The material of which this tooth is formed also extends forward for a short distance toward the base of the tooth in advance, so that when the lug *e* of the lever *l* strikes the insulating tooth in any instrument it shall not touch the metallic part of the wheel at any point.

Each circuit or escapement wheel is also provided with an extra tooth *u*, set at a distance from any of the others, and when the circuit is not being used, the lug *e* of each lever will be elevated and rest against the tooth *u*. This tooth *u* affords a convenient point at which each wheel may come to rest, so that after each revolution all the wheels shall be in unison.

The release magnet A, one of which is included in series in the line at each station, forms a unique feature of this system. It is shown more in detail in Fig. 5. A is a permanent magnet of hardened steel, to the poles of which are attached two soft iron pole pieces, P P, on each of which is wound a coil *a*. The strength of the permanent magnet may be adjusted by clamping the iron bar *q* at a point nearer to or farther from its pole pieces. The strength of the magnet at each station is so adjusted that it will just hold down the armature B mounted on the retaining lever controlling the toothed wheel *i* at that station.

The central office is provided with a battery and a key adapted to send a current of either polarity to the line, and also with an apparatus similar in all respects to that at each station, so that the operator may watch the positions of the wheels in their rotation.

The operation may now be readily understood. In order to start the wheels the operator depresses lever *k'* and holds it down. This sends to line a current of such a direction as to neutralize the polarity of each permanent magnet A so that all the levers are released, thus allowing all of the wheels to start under the influence of their clockworks. We will say that No. 5 is the station to be called. The operator watches the revolving wheel at the central station, and when the number 5 is under the index pointer *n*, she releases the lever, knowing that the insulating tooth at station No. 5 is then under the lug *e* on the lever at that station. The armatures of all the magnets are thus reattracted and all of the wheels again locked. The operator then depresses key lever *k*, which sends a strong current of the opposite polarity to line. This does not release the levers, as it strengthens the magnets A, but it does ring the bell at station No. 5, because the shunt which normally exists around the bells at each station has been removed from bell No. 5 by virtue of the lever resting against the insulating tooth on the wheel. The bells at all the other stations are short-circuited, and therefore do not ring. The contacts *c* at each station are provided for short-circuiting the bells when the levers are released. To bring all the wheels again to the normal position, with the tooth *u* of each resting against its lever, the operator depresses the releasing key as before and allows the

wheels to rotate until the tooth *u* is almost reached. Each wheel is then stopped at the tooth *u*.

Several systems depending on the same general principles as this have been devised, but none have met with success, so far as I am aware. Much trouble is experienced in keeping the wheels in synchronism, and another and more serious difficulty is the maintenance of the contacts in proper condition. This latter feature occurs as a fault in all step-by-step systems.

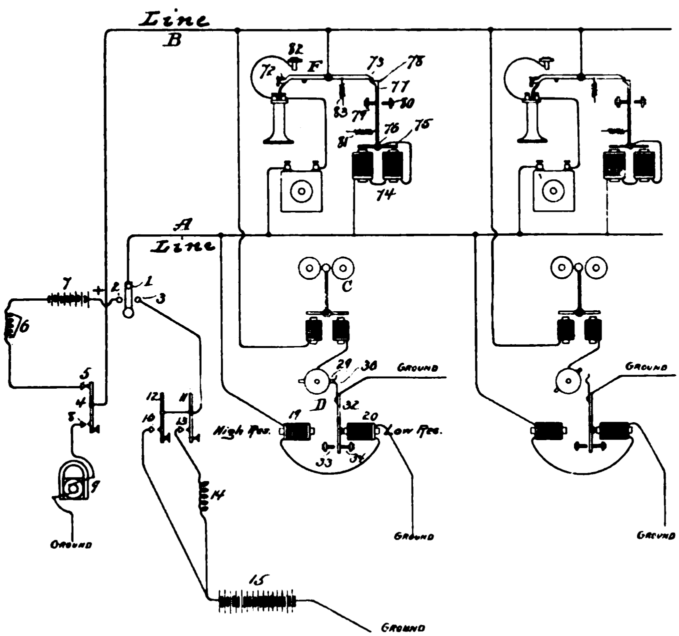


FIG. 6.

The patents controlling the Dickerson and the Anders systems have expired, and that on the Lockwood system will expire on November 1 of this year. These systems have all related to signaling on a single grounded circuit with instruments in series. A similar system devised by F. B. Wood in 1888, placed all the step-by-step magnets in a controlling wire which formed a complete metallic loop, and used this circuit merely to govern the step-by-step movements which completed the desired circuits successively in a separate wire over which the signaling was accomplished. Space will not permit of a complete description of this system, nor of one invented by Mr. John I. Sabin, of the Sunset Telephone Company, in San Francisco. In this latter system the magnets of the step-by-step mechanisms were placed in a third wire and used to successively close bridge circuits containing telephone instruments and call bells at the various stations.

A more recent invention by Messrs. R. T. Reid and J. L. McDonnell, of Tacoma, Washington, is adapted for use on two wires only, and also contains lock-out and automatic calling features. This system is illustrated diagrammatically in Fig. 6, and some of its mechanism shown in Figs. 7, 8 and 9. In Fig. 6 (the central office) the apparatus, for the purpose of clearer illustration, is shown in a greatly simplified form, the signal-transmitting apparatus being represented by manual keys. The step-by-step mechanisms are shown in this figure at D, and are bridged between the line wire A and ground at each station. The call bells C are of the usual polarized type, and are each contained in a normally open circuit between the line wire B and ground. This circuit at each station is adapted to be closed by the step-by-step movement.

The step-by-step mechanisms are actuated and controlled by two magnets,

19 and 20, placed in series and wound to respectively high and low resistances. The magnet 19 will, therefore, operate with a comparatively smaller current than magnet 20, owing to its greater number of turns.

Magnet 19, by means of lever 25, acts to step the ratchet wheel 22 around, this wheel carrying with it the contact arm 29 and the stop arm 31. These parts are mounted on the shaft as shown, the notched wheel 28 being provided merely to secure a proper angular adjustment

FIG. 7.

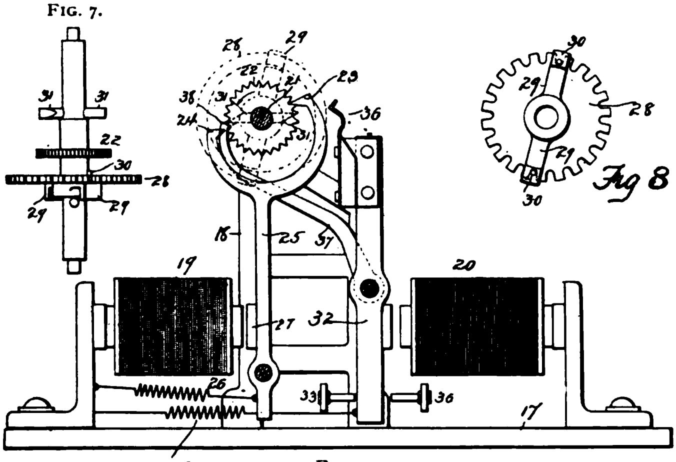


Fig 8

FIG. 9.

between the stop arms 31 and contact arms 29, this adjustment being different at each station. The low-resistance magnet 20 operates a contact arm 32, carrying a contact 36 insulated therefrom, and also a separate arm 37 adapted to engage the stop arms 31 and lock the shaft.

Referring again to Fig. 6, the lock-out mechanism is represented by magnets 74 and arms 76. These magnets are polarized so as to hold the arm 76 either under the hook lever F or away from it, according to the direction of the current traversing the coils.

The operation may now be understood. To call central, the subscriber removes his receiver from its hook, thus closing a circuit at his station across the two line wires and throwing the drop 6 at central by means of the battery 7. This attracts the attention of the operator. The circuit so closed between the two sides A and B of the line includes the magnet 74, and the current is in such a direction as to throw the lever 77 to the right, thus allowing the hook switch to rise and complete the telephone circuit at that station. After a plug and cord is attached to the line at the central station, a different battery of opposite polarity is connected with the line, and, should any other party remove his receiver from its hook, he will find the hook lever locked by reason of this reversed battery.

To call any particular party, the key 12 at central is depressed once and then released. This unlocks all of the lock arms 31 and moves all wheels forward one step. After this the key 11 is depressed a certain number of times. This throws a series of weak impulses on the line, which moves all the contact arms in unison. When a sufficient number of impulses have been sent, the arm 29 at the desired station is opposite the spring 36. The operator then depresses key 12 and sends a strong current to line and thus operates magnets 20. This closes the bell circuit only at the station desired, for the reason that the contact arms 29 at the other stations are not in the proper position to make contact with spring 36. The current from the calling generator is now thrown to line B, thus operating the bell of subscriber desired. After the required signal has been sent, key 11 is

again depressed a sufficient number of times to bring all stop arms into engagement with their levers 37.

The systems described in this article have been chosen as representative of a large number of a similar nature. It has been thought best to give a rather complete and detailed description with intelligible diagrams of a few such systems, than to describe in a more general way a greater number.

THE CARTY BRIDGING BELL CASE.

BY EDWARD E. CLEMENT.

This was a suit in equity in the United States Circuit Court for the Western District of Pennsylvania, on a bill of complaint filed November 4, 1896, by the Western Electric Company against the Millheim Electric Telephone Company et al. The patent held to have been infringed is No. 449,106, to John J. Carty, granted March 31, 1891, on an application filed August 16, 1890. The decision handed down awarded to complainants the decree prayed for. The prayer was the usual one for a preliminary and a perpetual injunction, an accounting of profits, and damages, the destruction or delivery of the infringing apparatus, and costs.

It is not my purpose here to go into the decision, which is not only eminently fair in tone — although to interested parties perhaps illogical — but is much clearer technically than most patent decisions; but rather to give some insight into the subject matter of the patent and its claims, the apparatus alleged to infringe, and what the decision covers.

Mr. Carty's invention is directed to the solution of that problem which has vexed so many telephone engineers and exchange managers — the party line. In the early days the individual signal engrossed the attention of experts as the probable solution of the many-party connection — that is, the arrangement of selective devices that would permit one station and one only to be called, no others being at the moment free, or in circuit. In such a system many arrangements of the selective relays might be had which would not interfere with the voice currents, and it was permissible to have the signals or ringers entirely disconnected until required. The practical operativeness of such devices, however, was discovered to be — at least at that time — problematical, and until recently, when Messrs. Sabin and Hampton, Dean and others have again essayed the old path, it has been abandoned.

Mr. Carty tried a different tack. He took the common series line and studied it to perceive what its salient defect was, and how that might be eliminated. He decided that the actuation of all the signals for every call was a permissible evil if the voice transmission could be rendered somewhere near as good as it would be on a one-party line. According to his testimony in this suit he attacked the problem of necessity, and in order to save a long line that would otherwise have to be abandoned. The solution of the problem was found in the arrangement of circuits at each station shown in the accompanying diagram, Fig. 1, which contains the substance of Fig. 2 of his patent drawing.

Referring to the figure it will be observed that the ringer R is permanently

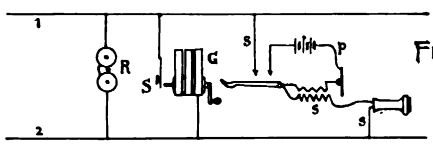


FIG. 1.

connected across the line wires 1 2. The generator G is in a normally open shunt adapted to be closed by a device represented in the figure as a strap key S. The talking set has its secondary circuit *s*, containing the receiver and secondary of the induction coil, in a second normally open shunt adapted to be closed, together with the primary circuit *p*, when the hook switch rises. The whole secret of the efficiency of this arrangement is the high resistance and impedance of the ringer magnets. Generator current in sufficient volume and of low frequency is able to pass through all the windings and ring all the bells, but voice currents are limited almost as completely to the two through line wires

as if there were no ringers in circuit at all.

It goes without saying that if this is a feasible arrangement for many-party lines it is also feasible for single-party lines, as there are two bridges when two such lines are connected for conversation. For this reason the claims of the patent were not all limited to multiple station circuits.

There are fifteen claims in the patent, of which 8, 9 and 10 cover individual station circuits having the permanently closed branch containing the ringer magnets, and normally discontinuous branches with the generator and talking set therein. Claim 15 is for the same elements, but does not limit the ringer branch to a permanent connection. It would be infringed by several arrangements that have been proposed to avoid the other claims. Claims 1 to 7 and 11 to 14, inclusive, are for combinations of the elements set forth in the claims already referred to, in a party line connection. They would be infringed by any system having a permanent bridge with a signal magnet therein, and another bridge or other bridges adapted to be connected in parallel therewith as occasion demands.

The circuits which formed the basis of the suit were substantially like the diagram, Fig. 2.

The similarity between these circuits and Carty's is apparent at a glance. In

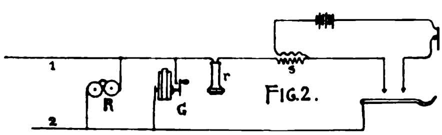


FIG. 2.

fact, other defenses failing, infringement was virtually conceded. In the figure, 1 2 are the line wires, R is the ringer permanently bridged, G is the generator, and *s* is the secondary talking circuit, *t* is the transmitter and *r* the receiver.

In Fig. 3 the automatic circuit-closer for the generator is shown. Here C forms one terminal of the generator circuit, while the other terminal is at the armature spindle in the usual manner. The spring A normally pushes disk B into the position shown. When the crank is rotated the pin and slot by a cam action cause B to be driven against A into contact with C. Of course, the actual construction here shown does not of itself constitute an infringing device, being merely a convenient adaptation of a well-known circuit-closer.

The testimony of a number of witnesses was taken in the case, the most important being that of the two experts,

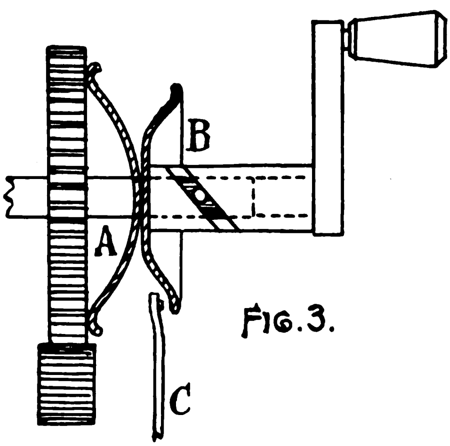


FIG. 3.

Mr. Carty himself and Mr. Kempster B. Miller. The main contention of the defense was that invention was not involved in the production of the system covered by the patent, but that as all of the elements were old and well known, both as to their construction and their properties, Mr. Carty had simply used the technical knowledge which he shared in common with every other telephone engineer to arrange his circuits so as to take advantage of the best results known to be possible. A great number of patents, both foreign and domestic, and printed publications, antedating Mr. Carty's alleged invention, were put in evidence and analyzed with minute care by Mr. Miller to support the contention.

The testimony was gone over at some length by the court in the decision, and the conclusion arrived at is best stated in the words of the judge who delivered the opinion. He said:

An examination of the many alleged anticipations does not disclose the particular combination here shown, or overcome the prima facies. If any or all of them might have suggested a combination of means and the placing of them in the relation shown in the device, it is not proved that any one so placed

them. None of the elements composing the combination are in themselves claimed to be new. It is the combination of them in new relations and the securing a new and useful result thereby that constitutes the basis on which the patent rests. It goes without saying that if each element of the combination can be found in the old art, if all of them abstractedly and separately considered perform the same function they did in the old art, this will not tend to defeat the patent if the old individual elements are here brought into novel combination with each other and their combined functions produce a new result. Such novelty, if the change involves patentability, constitutes ground for a valid patent. It follows, therefore, that to find in the prior art each element in isolation is not to anticipate the work of a patentee who by the inventive act first evolves combination out of isolation.

This is a strong decision, and while there are doubtless many arrangements peculiar of their kind, in party-line work, that would not come under the patent, still it should be well borne in mind that unless reversed or modified on appeal the decision confirms to the complainant the sole right to systems where the signal-receiving instrument at a subscriber's station is connected in parallel with the generator while the latter is being operated, or in parallel with the talking set. Any system looking in the direction of such arrangements should be made the subject of careful scrutiny before adoption.

SOME ELECTRICAL FACTS AND FIGURES.

In 1884 a 50-kilowatt dynamo was considered a large machine, while a 100-kilowatt Edison steam dynamo was justly called a "Jumbo." At the present time the largest size of generator built or building is of 4,600 kilowatt capacity. The price of dynamos in 1882 was about 20 cents per watt of output, while dynamos of similar running speed in comparatively small sizes, without switchboards, now cost about 2 cents per watt.

The cost of generating a kilowatt-hour of electric energy from steam for electric lighting appears to have been at least 7.5 cents at the 'bus bars in 1884. At the present time the cost of delivering a kilowatt-hour to large street railway systems from steam is only about 1 cent, and the power house operating costs are reported in some cases as low as ½ cent. In municipal electric lighting systems, supplied at low pressure from steam central stations and hampered by relatively heavy distributing expenses, the retail price of the kilowatt-hour varies from 20 to about 4½ cents, according to the locality and quantity consumed. Niagara power is now sold to consumers in Buffalo at rates varying, according to the amount delivered, from 2 cents to slightly less than ⅔ of a cent per kilowatt-hour delivered.

The price of a 16-candle power incandescent lamp sixteen years ago was about $1. Now it is about 18 cents.

Arc lamps were already so far advanced in 1884 that comparatively little improvement in their effectiveness has taken place, the gain having been made in economy of operation. Thus the carbons which cost at that time about 6 cents apiece now cost about 2 cents. The inclosed arc lamp has of recent years become popular, owing to its diffused light and a carbon life of from 100 to 150 hours.

It has been estimated that about $600,000,000 have been invested up to the present time in electric lighting stations and plants in the United States.

The best storage cells tested at the Philadelphia Exhibition of 1884 gave a yield, under laboratory conditions, of 3.4 watt-hours per pound of electrodes with an energy efficiency of sixty-nine per cent when discharged at the mean current density of 12 amperes per square foot of negative plate surface; while the deterioration was comparatively rapid. At the present time storage cells are in use giving, under laboratory conditions, a yield of from five to six watt-hours per pound of charged cell, with an energy efficiency of about eighty-five per cent, when discharged at a current density of 4.8 amperes per square foot of negative plate surface. There are now storage batteries installed in the United States to the aggregate capacity of about 56,000 kilowatt-hours. The largest installation has 166 cells, weighs 500 short tons, and has an eight-hour discharge capacity of 22,400 ampere-hours, or 3,136 kilowatt-hours at 140 volts pressure.—*Dr. A. E. Kennelly in Cassier's Magazine for October.*

SMOKE PREVENTION.*

BY W. H. BOOTH.

At the present writing there has been for some time a strike in progress in the South Wales coal industry. It is from South Wales that comes the "smokeless Welsh" coal that is so much used in London, regardless of its cost, by those who cannot master the firing of bituminous coal, or who have been so unfortunate as to have been loaded up with steam boilers put in by engineers who either did not know or did not care anything about the probable future of the work. For some time past Welsh coal has been practically absent from the market for the above-given reason, and many steam boiler owners have been hauled up before sundry magistrates to show cause why they should not abate the smoke nuisance they are making. These prosecutions take place under a certain law known as the smoke prevention act. A good deal of latitude is allowed under this act in cases where smoke cannot be entirely prevented, and steam users have been claiming in defense that as their furnaces are constructed for Welsh coal, it is impossible for them to burn bituminous fuel without smoke until the furnaces are altered, and in some cases orders have been made upon them to reconstruct these furnaces to burn bituminous fuel.

In one case time to the extent of several months has been given to do this, and no doubt before this is done there will be plenty of Welsh coal and the change will be put off and put off, and the periodic Welsh strike will come again and we shall then see how these same steam users will answer the next prosecution for smoke with the present orders to reconstruct unfulfilled. Seeing that Welsh coal is so very much dearer than bituminous coal in London, in spite of the arguments of some engineers, who harp on the old string that the best fuel is the cheapest in the end, which they appear to do as a cover to their inability to use bituminous fuel, it is a little surprising that more effort is not made to burn the bituminous coal, especially as it can be burned without smoke under proper conditions.

* *American Machinist.*

When burning bituminous fuel, smoke is sure to be made whenever the gases from the fuel on the grate rise directly upward among the tubes. This is the way the gases do escape in the ordinary construction of the majority of water-tube boilers. In consequence, these boilers are sure to smoke badly with bituminous coal, and cannot be cured unless their furnaces are put into the shape of the ordinary furnace of a Scotch or other horizontal boiler, fired internally or externally. In these boilers the whole of the products of the furnace travel together over the fire and toward the bridge and become considerably intermingled and homogenized. If, when so mixed, the mixture contains the requisite amount of air, the whole of the gases will be completely consumed, provided they are still at a temperature sufficiently high to enable combustion to proceed.

This is where one difficulty arises. If too much air be admitted this alone might cause smoke by excessive cooling, but the chief cause of cooling is obviously the comparatively cold plates of the boiler itself. If 1,000 or 1,500 degrees is a proper temperature for the gases, it is easy to see that a boiler plate at 350 degrees is a very chilly object indeed, and it is small wonder that freshly distilled gas from long flaming coal is cooled below the ignition point. In Lancashire boilers there are frequently water pipes placed across the internal tube beyond the bridge. So far as my experience goes, these are of little or no value as strength givers, and they are very effective in extinguishing nascent flames. When all these things are considered it is forced upon one's attention that to burn bituminous coal without smoke we must thoroughly mingle the gases with the correct amount of air and must prevent the mixture being too rapidly cooled. This latter can be effected by protecting the cold plates of the boiler by fire bricks. It is because the sides of the furnace of the externally fired boiler are of fire brick that these can be made to give out less smoke than internally fired boilers of the Scotch type, in which usually the fire is cooled by a water arch all over the furnace area. The ordinary

arrangement of the water-tube boiler is, however, about as bad as it can be designed to be. In fact, such boilers are only fit for coke and other smokeless fuels, as no attempt is made at gas and air mixture, but the gases are hurried straight up from the grate to the cold tubes and forthwith extinguished never to relight.

But there is an addition made to some water-tube boilers in the shape of an extra row of water tubes, below the ordinary sets, and these tubes carry a roof of fire brick, so that the sides of the furnace and a portion of the roof are of fire brick, and this roof compels the products of combustion to travel to a point some distance along the furnace at which combustion may proceed. The chamber above this fire-brick roof is also roofed in by a set of fire-brick tiles supported on the lowest row of ordinary tubes, and thus there is good prospect of securing smokeless combustion. One thing more is needful — the correct amount and application of a secondary air supply above the fire. This is usually supplied above the door and often in a solid stream. The position is correct, but the manner is incorrect. The air ought to be supplied in a multitude of small jets directed toward the fire over its area so as to facilitate the mixture with the furnace gas. Thus mixed and kept hot the gases burn at the bridge, and continue to burn if provided with a sufficient space in which to complete their combustion. There is danger of using too much air. Chemically, the total air required in a furnace is twelve times the weight of the coal. The secondary air above the furnace is apt to be admitted too freely. Its admission should cease gradually after each fresh charge of fuel is coked off or it will produce waste. Hence the use of automatic devices to cut off the air supply at the proper time. It is desirable to have this secondary air admission made positive by means of a fan, in order that air may be blown in while firing is in progress, when the chimney damper is nearly closed and the under grate supply of air should be diminished, pending the closing of the door. But in shutting off the secondary air supply it seems likely that the best results would be got by shutting it off a section at once, instead of by gradually closing the admission valve for the whole. Thus if there be three perforated air jet pipes it would seem better to close them one by one, in order that those still open should spurt with their maximum pressure, than to gradually close three together and render the jets of air sluggish. If the foregoing precautions fail to prevent smoke, side firing may be also tried. It involves no more labor than ordinary whole surface firing. Side firing of a furnace measuring 6 feet long by 4 feet wide may perhaps be best carried out by firing upon alternate corners. Thus at one time fire the left front and the right back corners over an area each 3 by 2 feet, and at the next firing cover the other rectangles. This will tend to more even admixture at the bridge, and enables a simpler air admission to be contrived, though as a rule much attention is not given to this item.

Recently I found air being admitted through a plain opening measuring 6 by 18 inches, an opening probably much too large in area and also admitting air unbroken and in a bad condition for mixing with the gases. Smoke, it is true, was being prevented, but probably at a considerable expense in the shape of excessive air and reduced evaporation per pound of fuel. It is well known that black smoke represents comparatively little in the shape of solid carbon, and that the prevention of smoke cannot be effected with any certainty of economy of fuel. This is because it pays better to use nearer the correct chemical amount of air and produce some soot, because of more or less imperfect mixture, than to pour in a larger excess of air and completely prevent smoke. This points to the great importance of minimizing the secondary air by introducing it as finely divided as possible. Clearly, with a sufficiently long refractory furnace tube, thorough admixture of the air would be effected and every particle of gas would be satisfied with its molecule of oxygen. But practical considerations limit furnace dimensions, and it is practically impossible to reduce air supply to its chemical minimum. With a chimney draft, attempts at proper admixture often

defeat themselves by paralyzing the draft. Herein comes the advantage of mechanical draft, which can be made to fit any conditions we are likely to impose.

It is thus seen that the combustion of bituminous fuel is a compound operation; the solid carbon burns on the grate by means of air admitted below the grate, and the volatile hydrocarbons burn above the fire by means of air admitted also above the fire. In each case the air requires admission in fine streams. This compound operation demands the draft to be varied to suit the fuel, and with chimney draft it is often the practice to have light dampers to the ash pit, so as to regulate the air admitted below the grate. This can be effected by means of the usual blast gates where the forced draft is employed. We have thus a considerable control over the rate of combustion of the solid fuel on the grate, but we have not much control, if any, over the rate of combustion of the hydrocarbon evolved from the green fuel. This fuel is thrown upon the fire, its hydrogenous gases are evolved quickly, and we must supply them with air or smoke will be made. As a rule, if fairly well arranged as regards fine division, the loss due to smoke prevention arises from the air supply being too long left on, and an automatically working closing device must be applied to prevent this.

An advantage of externally fired boilers so much employed in America is that a steeply sloping stepped grate may be used under them and fed by some mechanical means on the coking system, and the fuel may be made to travel sufficiently quickly down the slope to prevent an excessive flow of air coming through the grate. This cannot be done with English boilers, which are usually fired internally, and the problem of economical mechanical stoking is very much more difficult here than in America, for a fire cannot be made to travel and pack close upon a horizontal grate, no matter how the bars lift and creep. With gravity to aid this can be done, and if anything brings about the use of water-tube boilers here, probably this question of mechanical stoking will have as much as anything else to do with it.

EUREKA ELECTRIC COMPANY.

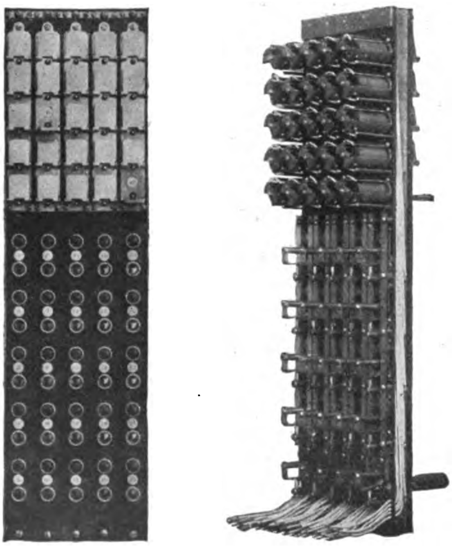
It was, no doubt, the general revival of business as well as a demand for a line of first-class telephone apparatus and supplies that induced the Eureka Electric Company to enter the promising field of the telephone trade. Located at 157-159 South Canal street, in the heart of the telephone manufacturing district, the new company bids fair to obtain a generous share of the business. Both the president, Mr. I. J. Kusel, and the secretary, Mr. H. J. Kusel, have had years of practical experience in the business, and with a wide acquaintance among the trade, have every assurance of success. Mr. I. J. Kusel entered the telephone field some years ago as president of the Missouri Telephone Company, at St. Louis, and under his direction the company built up quite a profitable business. For the last two years Mr. Kusel represented the American Electric Telephone Company as general salesman, while his brother, Mr. H. J. Kusel, filled a similar position with the Stromberg-Carlson Company.

The Eureka Company's salesrooms are very conveniently located opposite the Union Station, and in their stockroom they will at all times carry a large and complete stock of the best apparatus obtainable. The line will comprise long-distance apparatus, exchange telephones, interior telephones, switchboards, both self-restoring and manual types, at prices that will be low considering the high quality of the goods. A new lightning arrester and distributing board will be some of their strong sellers, including an improved form of cable box, as well as an efficient type of bi-polar receiver. All of their instruments are equipped with the Williams magneto, containing the Williams single-core ringer magnets. In transmitters they make the Bell solid back as well as the Ericsson type, both of which they guarantee for two years, and will replace free of cost any not satisfactory. They will also make a testing resistance box, which will meet a great want among telephone engineers. Being well equipped with a line of modern machinery, their factory is prepared to turn out any kind of special work on short notice.

VICTOR TELEPHONE APPARATUS.

The Victor Telephone Manufacturing Company, of Chicago, has recently completed its already extensive line of telephone apparatus, and is presenting to the independent field appliances having many advantages and unique features worthy of consideration. A description of some of their latest devices will undoubtedly prove of interest to our readers.

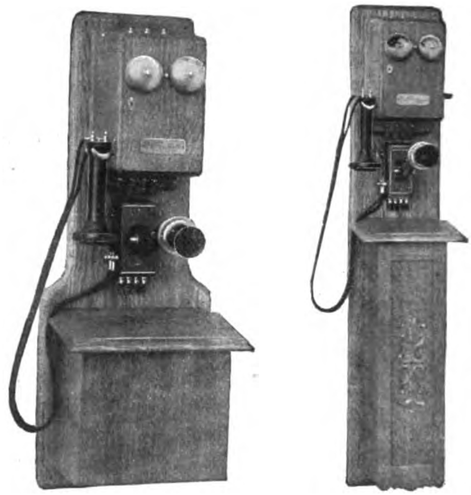
In the new Victor express switchboard, shown in front and back views, the company claims to have embodied all the desirable features of an up-to-date apparatus. For the board the Victor Company claims: Fewness and strength of



FRONT VIEW. BACK VIEW.
VICTOR EXPRESS SWITCHBOARD.

parts, ease and rapidity of operation, interchangeability of all parts, concealed wiring, ringing device adapted to all systems of circuits, and facility of adding any required number of drops without disturbing surrounding parts or interrupting the operation of the board. A more complete description of this board is given on the inside back cover page of this issue.

Victor telephones are constructed in three different types. Style C is their regular exchange wall set with double battery box back of oak, highly polished, equipped with their powerful generators and clear sensitive ringers; while in Style K is shown the long-distance set with extra long battery box. The switching device is made of heavy german silver placed in such a manner as to be quick and positive in action, and secured so as to avoid all possibility of disarrangement.



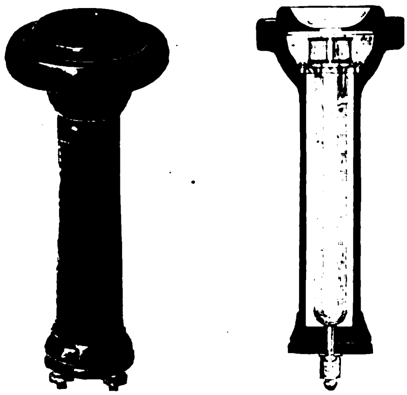
STYLE C. STYLE K.
VICTOR TELEPHONES.

The Victor Long-Distance Arm Transmitters shown are made on the most scientific basis. The carbon disk is held in a hard rubber cup, and is corrugated in such a manner as to aid in sustaining the globules evenly distributed within the retaining fiber, thus avoiding the accumulation of moisture, or the packing caused by excessive weight in lower part of receptacle. The annoyance and interruption of service caused by this common source of trouble certainly often proves disastrous to the best telephone

VICTOR LONG-DISTANCE ARM TRANSMITTER.

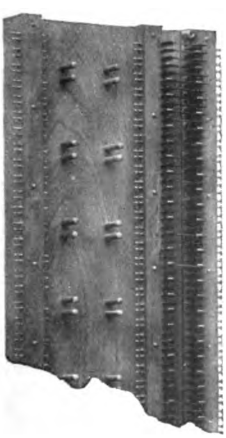
systems. The transmitter is also furnished with a flat back, where the induction coil is placed with the magneto or in some other place.

The Victor bipolar receiver is made in three different types: The regular large size shell, the pony type and Bell flare. Below the regular large size is shown,



VICTOR DOUBLE-POLE RECEIVERS.

together with a cross-section, showing the superior construction of the parts. These receivers contain powerful magnets of the best Tungsten steel, which are securely fastened at lower end of shell, the ends being milled so as to receive the projecting ends of coil magnets, which are fastened to a plate resting on a flange in head of the receiver, thus avoiding all variations caused by contraction or expansion, making the

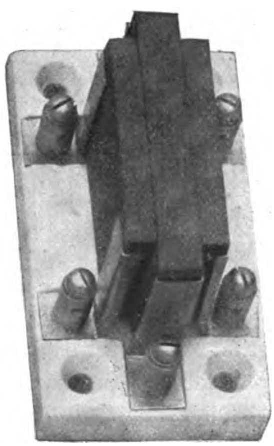


VICTOR CROSS-CONNECTING AND FUSE BOARD.

adjustment permanent. This same system applies to all the types.

The Victor Company's cross-connecting or fuse board is a most complete and at the same time inexpensive device. It is mounted on a strip nine inches wide, allowing the line connection to be made on one side passing through fuse link (under which is the ground strip) to the second connecting point, from which it is carried to any desired point connecting with switchboard cables. The ease with which common return, ground or metallic circuits may be converted, makes it indispensable for exchanges using the different systems.

Another production of this company is a carbon lightning arrester, shown below, which is properly termed the Victor Combination Non-disconnecting Lightning Arrester and Induction Absorber.



VICTOR NON-DISCONNECTING LIGHTNING ARRESTER.

This simple little device is most effective in its application. There are three carbon disks placed in parallel, separated at each end by narrow strips of mica and held in position by brass terminals to which are fastened binding posts. The center carbon being grounded, and each side forming a connecting link for metallic circuit, permits the circuit to remain closed at all times, and owing to the slight space between the center or grounded carbon, any high potential or foreign current is readily conveyed to ground. For use on grounded circuits, the main line is connected to center carbon and both side carbons grounded, thus relieving the line of induction commonly encountered on grounded circuits.

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CHICAGO, OCTOBER, 1898.

SINCE the rendition of Judge Buffington's decision in the cause of the Carty Bridging Bell Patent some two months ago, it has developed that considerable misapprehension exists among telephone men as to the exact nature of the claims litigated and the scope of the decision. For this reason, and as it is the intention of the TELEPHONE MAGAZINE to inform its readers on these points when important decisions are announced, we present elsewhere in this number a brief statement of the case, which, so far as it goes, may be relied upon as authoritative.

CONSIDERABLE criticism has reached the editor over the apparent advocacy by ELECTRICAL ENGINEERING of the new illuminant, through the publication of Mr. Lake's article on acetylene. This criticism is unfair, as no stand was taken either for or against acetylene, the article simply giving such information as was thought to be of value to the electric light manager. That acetylene will affect the value of the small electric lighting plant is shown in the article mentioned, and the reasons given are based on the author's knowledge of the development and progress in the acetylene field, and particularly as to its effect on existing electric lighting plants.

Those who criticised the information given are like the ostrich hiding his head in the sand. He shuts his eyes without changing the situation. It cannot be denied that there are today a number of smaller electric lighting plants which are not operating under particularly favorable conditions. The question simply is, whether the owner, at a slight additional investment, shall increase his revenue, or be driven from the field by his younger rival.

TELEPHONE COMPANIES COMMON CARRIERS.

The principle that a telephone company is a common carrier has once more been established in the Superior Court of Sacramento County, California, by the decision of Judge F. T. Nilon. There are two telephone companies in Sacramento, the Sunset Company (Bell), and the Capital Company, an independent exchange. The Capital Company ordered put into its own office one of the telephones of the Sunset Company, claiming that it needed it in its business, as it probably did. The Sunset refused to help out a rival to this extent and the courts were invoked. It has now been decided that the Sunset must furnish a telephone to the Capital upon the same terms as to other subscribers, but the decree also says that the Capital Company is not entitled to use its Sunset telephone to transmit messages received from its (the Capital's) subscribers or for which it intends to collect pay.

In a lengthy decision, Judge Nilon, after reviewing the evidence, made the following order: That a peremptory writ of mandate issue commanding respondents, the Sunset Telephone Company, to permit the petitioner, the Capital Telephone Company, to have one of respondents' telephones, with proper

connections with the Sacramento City Exchange, and to furnish facilities for transmission in the regular course of business to the subscribers of respondent to whom they may be directed, all verbal communications of petitioner relating to its own private business; not including, however, the messages received by petitioner from its subscribers in respect to which any toll or consideration has been or is to be paid to petitioner. As to the alternative writ of mandamus heretofore issued, the writ will be dismissed in so far as it commands respondent to furnish telephone facilities to petitioner for the transmission by petition — or through respondent's telephone in its office — of any message or communication in respect of which any toll or consideration has been paid or is to be paid to any other than the Sunset Company.

DEFEAT FOR THE BELL COMPANY.

Another attempt of the Bell organization to uphold one of its presumably valid patents has been defeated in the United States Circuit Court, Western District of Michigan, by the decision of Judge H. F. Severens, in the case of the Western Electric Company against the Citizens' Telephone Company, of Grand Rapids.

The suit was on the patent of E. T. Gilliland, No. 266,806, of October 31, 1882, alleged to cover any means for closing a circuit at a subscriber's station by the act of rotating the generator shaft. The case was argued by Mr. C. C. Bulkley, attorney for the American Electric Telephone Company, of Chicago, who undertook the defense of the suit, and was submitted a year ago last June. On September 12 last the case was again argued and a decision handed down by Judge Severens in favor of the defendant, holding that the apparatus used by the Citizens' Company did not infringe the patent sued upon, and construing the patent to cover merely the particular construction shown and described.

Judge Severens' opinion intimates quite strongly that a claim for a result or the mode of operation of an apparatus is untenable, and points out that the claims sued upon in the Gilliland patent are for a result or mode of operation. He does not decide this point, because he holds that the device used by the defendants did not infringe the claims.

The Bell Company have a number of overlapping patents, by which they hope to catch the unwary "going and coming," the claims of which are distinguished from that which is old simply by a statement of a mode of operation or a result. These claims would probably be held invalid by Judge Severens in any case decided by him.

CHICAGO ELECTRICAL ASSOCIATION.

The fall programme for the meetings of the Chicago Electrical Association has been prepared and issued by the secretary, Mr. J. R. Cravath. The meetings are held on the first and third Fridays of each month from October to May, inclusive. A special paper on some interesting topic has been prepared for each evening, and the ability of the authors is a guarantee of the high quality of the subjects treated. The list of papers arranged for until February next is as follows:

OCTOBER 7, 1898.
"Electrical Features of the Late Spanish-American War,"
THOS. G. GRIER, Western Electric Co.

OCTOBER 21, 1898.
"Practical Points on Electrical Measurement,"
W. B. HALE,
Cable Testing Department, Western Electric Co.

NOVEMBER 4, 1898.
"The Electrical Equipment of a Model Printing Establishment,"
GEORGE A. DAMON,
Electrical Engineer, with B. J. Arnold.

NOVEMBER 18, 1898.
"The Development of the Motor-Cycle,"
F. B. RAE, Electrical Engineer.

DECEMBER 2, 1898.
"Practical Points in Street Railway Engineering,"
W. A. HARDING,
Master Mechanic and Electrician, Calumet Electric Street Railway.

DECEMBER 16, 1898.
An Address by ARTHUR V. ABBOTT,
Chief Engineer Chicago Telephone Company,
on "Wireless Telegraphy" (illustrated by apparatus).

JANUARY 6, 1899.
"Telephone Engineering — Some Problems, Solved and Unsolved."
S. G. McMEEN,
Chief Engineer Central Union Telephone Co.

JANUARY 20, 1899.
"Observations on Ventilating Fans,"
GERARD SWOPE, Western Electric Co.

THE MODERN EXTENDED USE OF THE TELEPHONE.

Of the many uses to which the telephone is now being put outside of public exchange work, the private-plant system for large offices is probably the most developed.

In plants for this purpose the central-station system has always been considered impractical where it could not be of such size that a switchboard requiring the constant attendance of an operator could be used, owing to the large amount of time required for an irregular attendant to make a desired connection.

To evade the delay in connecting one station with another in small plants, many devices have been evolved, from an ordinary strap switch to the automatic, usually complicated switchboards. But the system that has probably the best reputation for being thoroughly practical and reliable is the intercommunicating system some time ago placed on the market by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago.

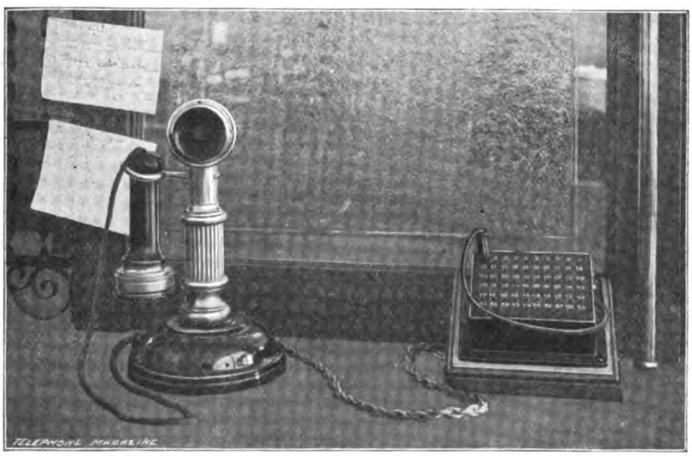


FIG. 1. SIXTY-POINT PLUG BOX.

One of the largest and most convenient systems of this kind has recently been installed by this company at the People's Gas Light and Coke Company, at their new offices, Michigan avenue and Adams street, Chicago. This plant well shows the extent of the use and convenience of private telephone systems.

Fig. 2 is an interior view of one of the application offices on the main floor, showing six private-plant instruments, one at each application window, and also three telephones connected with the public exchange.

Each office on this floor is furnished with an instrument consisting of a portable desk telephone and a 60-point plug box, shown more fully in Fig. 1. Any one of these instruments can be directly connected with any of the instruments in the bookkeeping department shown in Fig. 3. Each bookkeeper's desk is furnished with a long swinging arm telephone and plug box, and any one of their instruments can also be connected directly with any of the offices on the main floor.

In this system the user is not required to first call an operator at a central office, but completes the calling circuit to the station wanted by inserting the plug in the number desired, regardless of where the plug of the called instrument may be. In this way should a user neglect to disconnect an instrument when through, or fail to place the plug in the home number, it does not prevent that station from being called by another, as is the case in all ordinary strap-switch systems. The talking circuit is completed by the party calling placing the plug in the home number. In addition to this system between the bookkeeping department and the main floor offices, and entirely independent, is a system of the same kind between the officers of the company and the heads of departments.

Fig. 4 shows a pedestal beside the desk in President A. M. Billings' private office, with a desk telephone and plug

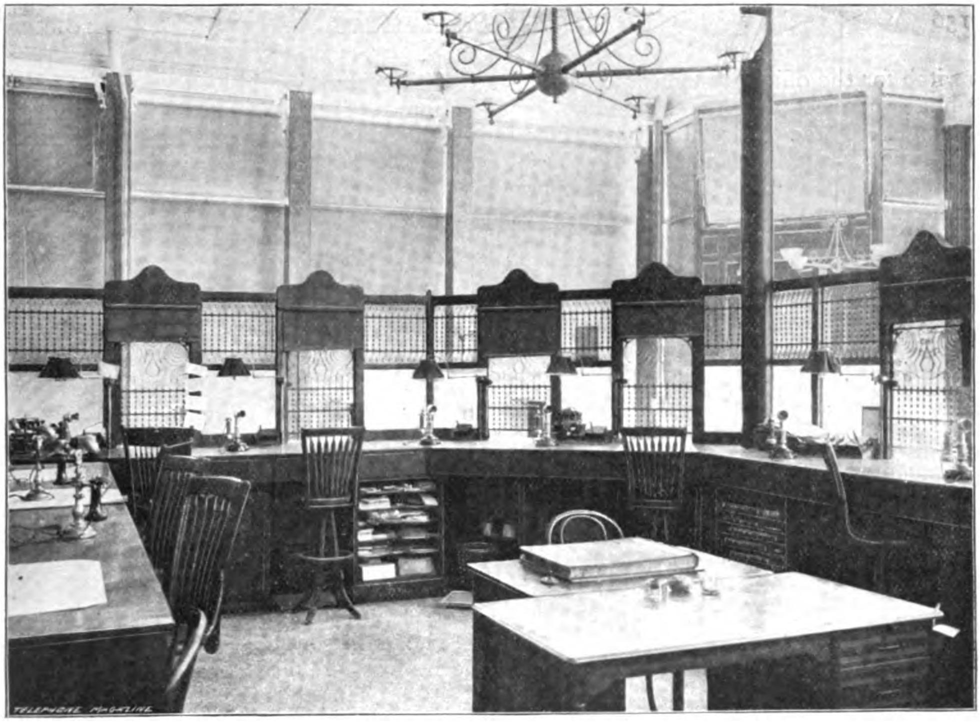


FIG. 2. VIEW OF APPLICATION OFFICE.

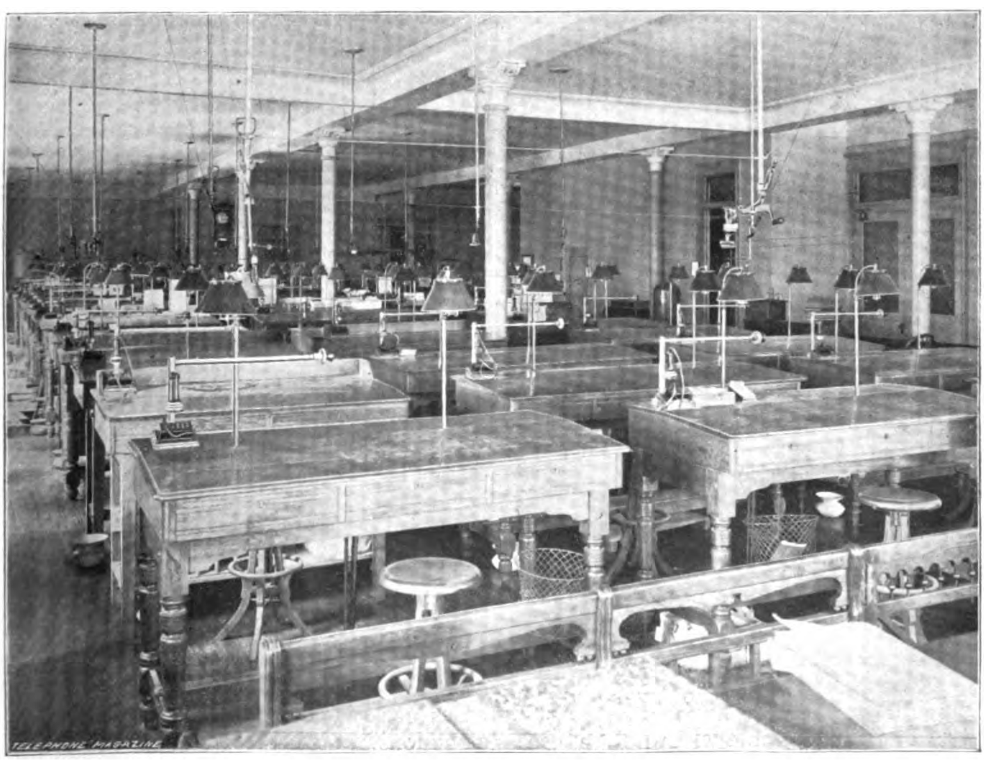


FIG. 3. BOOKKEEPING DEPARTMENT.

switch for the office system, and a telephone connected with the public exchange. These pedestals are furnished with the private system and made special to accommodate the public exchange telephone as well as the private-plant instruments.

The instruments used in this system are the regular Stromberg-Carlson long distance telephones, and in cities where independent public exchanges have been established, the private system is connected direct with the public exchange, and the separate instruments are not required.

This system can be made with a generator call bell or battery call. Where the distances are not too great the battery call is most convenient, and where a large amount of outside construction is required, the generator call is considered the most satisfactory.

In the battery call system the ringing and talking batteries can be placed at the central office.

Fig. 5 shows a combination set used

FIG. 4.

extensively in this system, as well as for public exchange use. It is very convenient for roll top desks, as it can be placed in a pigeonhole when not in use.

This system is said to be used not only in many of the largest business houses in the principal cities throughout the United States, but is being installed in

FIG. 5.

many large residences, hotels, public institutions, factories, and for connecting the various pumping stations in mines with the mills and offices. When once properly installed, it is claimed to require practically no attention.

The entire system is claimed to have been most carefully worked out in all its details. The objectionable cross-talk, so frequent in systems where a common return wire is used, is entirely avoided by the peculiar arrangements of circuits. This feature alone, with other valuable points, would seem to make it one of the most desirable systems to use where rapid and reliable communication between different departments is required.

A USEFUL APPLICATION OF THE TELEPHONE.

Telephone instruments incased in waterproof boxes are placed on the side poles at every turnout along the electric railway, where cars pass each other, and orders are given conductors at these telephone stations by those at the general offices, the same as railway trains are run by telegraph, says the Racine *Times*. If a car arrives at a certain siding where it expects to meet another car, and that car is not there, the superintendent's office in Racine is notified by the conductor. He then receives orders. The telephone is also used in all cases of delay or accident along the line, and conductors in such cases are given prompt and definite instructions.

ACETYLENE AND ELECTRIC LIGHT PLANTS.

II.—BY C. E. LAKE, E.E.

That acetylene is taking a firm hold in other countries besides the United States is shown from the reports of journals published on the Continent. In London an exhibition was held last July, at which some thirty different makes of acetylene generators now on the English market were shown. The *Journal of Acetylene Gas Lighting and Calcium Carbide Review*, which calls itself the "Pioneer Journal of a New Industry," says in speaking of the exhibition:

It may be now accepted as a fact that acetylene lighting is finally established as one of the staple industries of this country. Its progress has been not only rapid but sure. The apprehensions of the public as to the "danger" of acetylene are now practically dissipated, and we may henceforth look forward to its regular utilization over a large and extending field.

There can be no doubt that the demonstration of acetylene lighting organized at the Imperial Institute is responsible for a substantial impulse in the curiosity felt by the general public in the means of illumination surrounded by so many interesting features, though it can hardly be expected that the results of this highly successful exhibition will be fully felt for some time to come. The array of generators at the Institute which have worked, as a whole, without a hitch during a considerable period, must satisfy any reasonable person of the safety and innocuous nature of the illuminant; while its beautiful appearance, as displayed in the galleries, has been apparent to, and acknowledged by, all. As we have said, the stimulus afforded to the industry by the exhibition at the Imperial Institute will not probably be felt in its full force at first. Its chief merit, perhaps, consists mainly in its educational character, and it has to be viewed in this light by those exhibitors at the Imperial Institute, whose expectations of a purely commercial character have perhaps not been entirely fulfilled.

Taking the acetylene industry all round, we are entitled to pride ourselves on the fact that it is at least as well advanced as that of any other country, while totally free from those casualties which have marred it on both the Continent and the United States.

Throughout France acetylene plants have already displaced over one hundred of the small electric lighting plants, while the India and Oriental markets are rapidly being developed by the English and French manufacturers. Lighting by acetylene is already a business that cannot be ignored by the electric lighting fraternity.

The following extract from a paper read before the Gas Institute in Ireland indicates that nearly the same conditions exist in Great Britain as exist in this country.

UTILITY OF ACETYLENE.

The illuminating value of the gas, when burnt under the best conditions for developing its marvelous light-giving powers, is 240 candles per 5 cubic feet; but these conditions cannot be fulfilled in practice, and when burnt in the 1-foot burners best adapted for its use, the illuminating power actually obtained is at best only 35 candles, which makes it, for ordinary use, a 175-candle gas. So that, as far as illuminating value goes, it is about eleven times the value of coal gas; but as it costs about thirty times as much as London coal gas in the holder, the dread of it as a rival for town supply need not at present strike terror into the gas manager's breast. Moreover, the 35 candles per foot obtained in a 1-foot burner is only twice the value obtained from a foot of ordinary coal gas by means of the incandescent mantle, and it is at once seen that no rivalry can exist between the two where the consumption is on a large scale. On the other hand, as the quantity of ordinary coal gas to be made grows smaller, the cost of making it increases in an enormous ratio, so that, while the South Metropolitan can make gas at 1s. 2d. per thousand in the holder, and shows a handsome profit by distributing and selling at 2s. 6d. per thousand, there are many villages and small towns in which, owing to their straggling nature and small consumption, coal gas could not be sold profitably at 10s. a thousand; and it is in such places and in country houses, railway stations and large institutions, that acetylene is at present making considerable headway, not as a competitor with coal gas, but rather as a rival of the electric light and oil lamp.

The field of utility is, however, restricted, and as company after company is formed to exploit some form or other of generator, those who are best able to judge cannot but see that the field of operation for undiluted acetylene is so limited, and the number of forms of generators so large, that at best only a very moderate return on the capital invested can be expected.

THE Citizens' Telephone Company, of Grand Rapids, Michigan, has contracted with the American Electric Telephone Company, of Chicago, for furnishing the New American Rapid Transfer System with electric light signals to their 3,000-line switchboard. This system is to replace the old-style drop signals, and is claimed to be the most perfect device of the kind yet produced.

SOME NEW KEYSTONE SWITCHBOARD DEVICES.

In none of the various devices that enter into the equipment of a modern, efficient telephone exchange is such perfection and high quality necessary as in the several parts of the switchboard. In

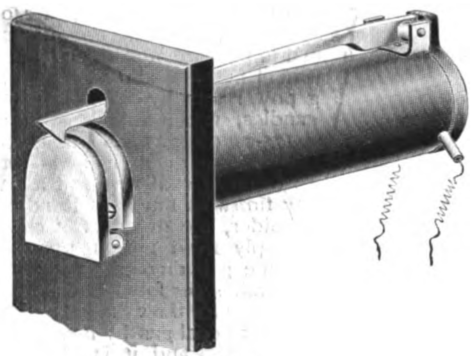


FIG. 1.

the board as now manufactured by the Keystone Telephone Company, Pittsburg, are contained several good features worthy of special mention. The long tubular drop shown in Fig. 1 has been found particularly efficient, as the long spool admits of the wire being kept near to the core, thereby necessitating a minimum of current for the working of the shutter. The latter is made extra heavy, so that in falling it will make absolute contact for the night bell circuit.

The jacks, one of which is illustrated by Fig. 2, are of very simple construction, and can be instantly removed from the board if necessary. They are so

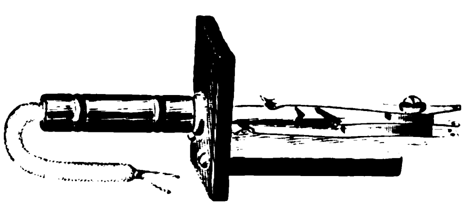


FIG. 2.

arranged as to admit of heavy german silver contact springs, and are claimed to be the most substantial jack made. Another excellent feature of the Keystone board consists in the ringing and listening cam. (See Fig. 3.) In this, also, exceedingly large and heavy contact springs are used, that will insure absolutely against trouble at this particularly weak point. Switchboard cams are subject to very hard usage, and must be made heavy and strong enough to stand without repairs for a long time. This feature is claimed to be a particularly valuable one by the company.

In the arrangement of the drops and jacks, the drops are placed above and the jacks under them, with ten pairs plugs and ten cams for each 100-drop section. The manufacturers say that this board follows as closely as possible the lines of the Bell apparatus, and

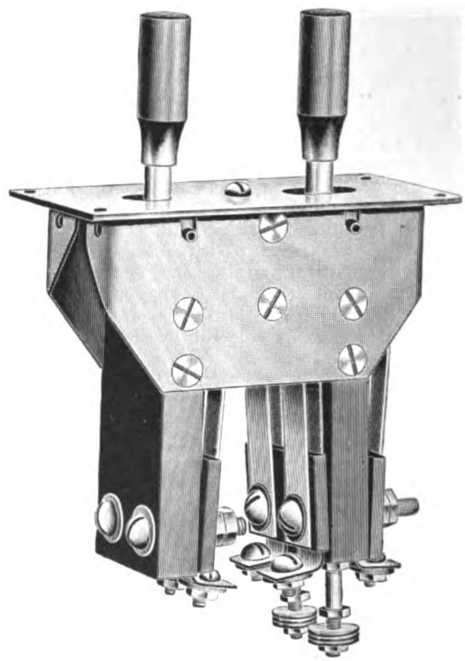


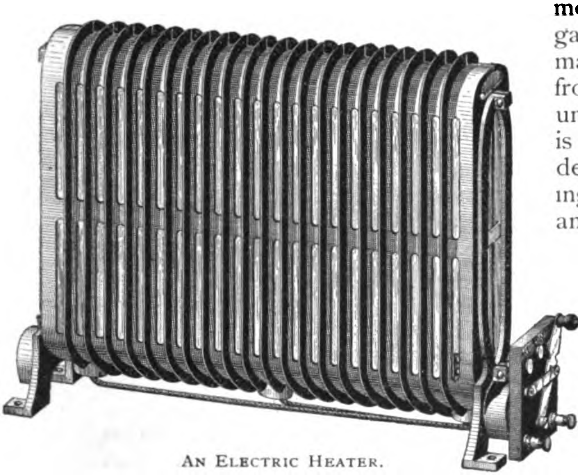
FIG. 3.

to those desiring that particular design the Keystone Company will be glad to quote prices. Being conveniently located at Pittsburg, in the heart of the commercial center, the company is in a very favorable position to make low figures on all kinds of telephone and exchange equipment, while the numerous lines of railways of that city give them the very best of shipping facilities to all parts of the world.

The saddest words of tongue or pen
Are these: "Line's busy — call again."

FOR THE COLD WEATHER.

The electric heater has a wide field of application in heating small offices, bathrooms, snuggeries, cold corners of rooms, street railway waiting rooms, the summer villa on cool evenings, and in mild climates a still wider range. It has the



AN ELECTRIC HEATER.

peculiar advantage of being instantly available, and the amount of heat is regulated at will. The heaters are perfectly clean, do not vitiate the atmosphere, and are portable. No definite rule can be given to determine the amount of electricity necessary for heating a given space, though approximate estimates can be made by allowing from 1 to 2 watts for each cubic foot of air space to be heated, the latter amount for well-constructed buildings in cold weather or for quickly heating a bathroom. The electric heater is extremely valuable in the late spring when furnace fires are not in use and a sudden raw spell comes on, as the electric current is immediately available and takes the chill from the room at a minimum expense and trouble.

The Western Electric Company's heater, made in the shape of a small steam radiator, is 14½ inches long, 3⅜ inches thick, stands 12½ inches high, and is finished in black enamel or japan. It is made for two adjustments, half capacity and full capacity; the switch indicates when the current is off, when half of the heater is in use and when it is all in use.

The heater is made for 52 and 104 volts suitable for alternating currents, and also for 110 and 220 volts to be used on direct-current circuits.

SOME NEW HUNT CATALOGUES.

Three new catalogues just issued by the C. W. Hunt Company will prove most interesting and attractive to all engaged in the handling of machinery or material, or in the transmission of power from place to place. In No. 9,805, under the title of "Industrial Railways," is given a very complete and elaborate description of a system of railways meeting the most exacting requirements of any manufacturer.

Catalogue No. 9,807 treats of mast fittings, coal tubs, hoisting blocks and wheelbarrows, and contains an amount of information on those subjects seldom found so complete and extensive.

The handsome booklet numbered No. 9,811 is called a brief treatise on manila rope, but contains in reality a most elaborate treatment of the subject hardly expected in a trade catalogue. It treats of ropes used for the transmission of power, and gives a number of formulæ, tables and valuable data of the greatest value to all engaged in mill engineering.

All three of the pamphlets are gotten up in the usual handsome style of the Hunt Company, and their beautiful execution typographically is well in accord with the well-known high quality of the Hunt Company's products.

STANLEY ELECTRIC MANUFACTURING COMPANY, whose alternating-current apparatus has for years been recognized as standard, has recently arranged with the Western Electric Company to exclusively represent it in the following territory: Michigan, Ohio, Kentucky, Tennessee, Alabama, Mississippi, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Arkansas, Louisiana, Texas, Indian Territory, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Montana, Wyoming, Colorado and New Mexico. A complete stock of transformers and other appliances to insure prompt shipment will be carried in Chicago.

RECENT PUBLICATIONS.

"In the type-case of the printer, all the wisdom of the world is contained, which has been or ever can be discovered. It is only requisite to know how the letters are to be arranged. So, also, in the hundreds of books and pamphlets which are every year published about ether, the structure of atoms, the theory of perception, as well as on the nature of the asthenic fever and carcinoma, all the most refined shades of possible hypotheses are exhausted, and among these there must necessarily be many fragments of the correct theory. But who knows how to find them?

"I insist upon this in order to make clear to you that all this literature, of untried and unconfirmed hypotheses, has no value in the progress of science. On the contrary, the few sound ideas which they may contain are concealed by the rubbish of the rest; and one who wants to publish something really new—FACTS—sees himself open to the danger of countless claims of priority, unless he is prepared to waste time and power in reading beforehand a quantity of absolutely useless books, and to destroy his readers' patience by a multitude of useless quotations."—HELMHOLTZ.

TECHNISCHE LEHRHEFTE. MASCHINENBAU. HEFT 8—BERECHNUNG UND AUFRICHTUNG DER WASSERRÄDER. Von F. Beyrich, Ingenieur. 55 pages, 7 by 10; 33 illustrations; paper, uncut; price, 1 80 mark. HEFT 6.—BERECHNUNG DER DAMPFMASCHINEN. Von Jos. Kessler, Ingenieur. 48 pages, 7 by 10; 25 illustrations; paper, uncut; price, 1.40 mark. Hildburghausen: Otto Pezoldt, Technische Buchhandlung.

These two little volumes form part of a technical series composed of short treatises on engineering subjects by practical engineers, intended to serve primarily as instruction books in technical schools, but as they are written so concisely and do not expand into long theoretical investigations, the engineer will find in them a welcome assistant. In fact, the contents are nothing else than a computation of the formulæ required for the calculation of water wheels and steam engines and the determination of their efficiencies, accompanied by an outline of the theory as far as it is essential to enable the reader to correctly apply the given rules, which are, besides, illustrated by numerous examples. Higher mathematics are entirely left out—not that the establishment of the formulæ does not require them; for theory, certainly the theory of steam engines involving thermodynamics cannot do without calculus—but here the final results only are given, which may be sufficient for all practical purposes, though it may not satisfy the scientifically inclined student.

It may be well to devote a few lines to the matter given. In the monograph on calculation and construction of water wheels, their classification and the limits of application, the latter illustrated graphically by the well-known diagram of Redtenbacher, form the introduction, followed by the determination of effect and efficiency of water wheels. The calculation of circumferential velocity, radius, width of wheels, dimensions of buckets, number of arms and other construction details finishes the first part, while the second part gives the physical theory underlying the motion of water and the application of this theory to all classes of water wheels that have any claim to efficient working. The third part contains some further construction details, and includes also the determination of the weight of wheels and their regulation.

Of course, this little book is not complete in itself. It forms only a part of the great science of machine construction, and presupposes a knowledge of the dimensions of machine parts and a general acquaintance with mechanical principles. So does the second monograph on steam engines, in which the author, first of all, reviews the theory of heat so far as it pertains to the subject, and then devotes considerable space to the effect of the single-cylinder expansion engine, the other engines being only a multiplication of this one.

In the treatise following, the indicator diagrams play a great rôle, plenty of them being reproduced as obtained by the indicator, so that effects caused by faulty construction of the engine, as well as inefficient management, may be studied from them. Compound and triple-expansion engines are discussed so far as their effect is concerned, and an example for the calculation of one of each kind added.

This volume is intended only for instruction in calculating, while a second volume will treat of the construction of steam engines. There is plenty of good material contained in the limited space, the whole arrangement of the "Lehrhefte" (didactical papers) being a credit to the authors as well as to the publisher. We may be allowed to suggest that in future volumes or new editions the authors add a list of the literature covering the subject under consideration, so that the student may be able to extend his studies whenever occasion for doing so presents itself. C. E. K.

THE HEAT EFFICIENCY OF STEAM BOILERS: LAND, MARINE AND LOCOMOTIVE. With tests and experiments on different types, heating value of fuels, analysis of gases, evaporation, and suggestions for testing boilers. By Bryan Donkin. London: Charles Griffin & Co., Ltd., Exeter street, Strand. 311 pages, 7 by 8½, cloth; price, 8 shillings.

Every engineer, certainly every mechanical engineer, will remember the numerous boiler tests of Messrs. Donkin & Kennedy, that appeared in London *Engineering* during the last years. These tests, in conjunction with some new ones, and many made on the Continent and in America, are collectively reprinted here, and form the basis of a treatise on boiler efficiency. We are pleased to have such an authority as Mr. Donkin give his opinion on a subject which is of so great importance, and in many cases not valued as highly as it merits. We fully agree with him that it is not the type of the boiler but its management that pushes its efficiency up to the top notch, and if the author can by this discussion induce the owner or attendant of the boiler to make a more scientific investigation of its working, he will have accomplished a praiseworthy object. Ahead of the tabulated boiler tests a short description of the various types of boilers presents to the reader the characteristic features of each kind. The test tables are followed by a review of grates and mechanical stokers. To make the work complete in itself, the author added a chapter on the combustion of fuel in boilers, and in another chapter the results of elaborate tests made by various experimenters of note upon the transmission of heat through boiler plates are given. Feed-water heaters, superheaters, economizers, feed pumps, etc, also find due space. A special chapter is devoted to smoke and its prevention.

In discussing the instruments used in boiler testing, our American calorimeters find preference over all others, on account of their simplicity and reliability, while in fuel testing stations we are somewhat behind, Germany taking the lead in the establishment of such stations, the one at Munich being the most important and best-known one. [Unfortunately, during the last year or two funds became scarce, and its doors had to be closed for the present.—ED.] A discussion of the trials and conclusions derived therefrom, also advices regarding the choice of a boiler and testing it, form the final chapters. In an appendix the author extracts some valuable data from current literature, such as on the cost of generating steam, etc.

Toward the end of this century, where transmission of energy over large areas and long distances has been made possible, where many thousands of horse-power are now generated in one central station, and where steamboats are built, the propulsion of which requires from 15 to 25,000 horse-power, the saving of only one per cent in the fuel bill is of great value, and to obtain such savings the engineer must study economy, which he can do only by experience gained from the past. The boiler, where the first loss of energy in the long chain from coal heap to consumer occurs, offers a splendid subject to the engineer for the application of his knowledge. We therefore have every reason to be thankful to the author for his willingness to share his experience and the fruits of his labors with his confrères who have not the opportunity to investigate on their own account. We sincerely hope Mr. Donkin will not stop short at this point, but provide us with further material to study the heat efficiency of the steam plant in the transit from boiler to belt — the steam engine, with its present extremely low utilization of the heat contained in the fuel, lending itself more than anything to the application of deep thought and study. C. E. LAKE, E. E.

PERSONAL.

MR. A. M. MORSE, one of the pioneers in the designing and constructing of steam plants for electrical and other purposes, is once more associated with the firm of engine builders with whose products he had such good success in the early days of electric lighting, the Atlas Engine Works. In a centrally located suite of offices, 1520 Marquette building, Mr. Morse is prepared to receive all old and new friends, and supply any demand in the engine or boiler line.

USE OF STREETS FOR TELEPHONE SYSTEM. — The reasonable use of the streets of a city for the equipment of a telephone system, including poles and wires, is held, in Magee *vs.* Overshiner (Ind.), 40 L. R. A. 370, to be a lawful use, and not a new and additional servitude for which the abutting owner can claim compensation.

INDEPENDENT ITEMS.

NORTON, KAN., is to have an independent telephone exchange.

ELLENDALE, N. D.— E. E. Bodle has purchased the Midland Telephone Company.

MADISONVILLE, R. I.— Mr. J. T. Alexander will establish an exchange at Providence.

STEVENS, PA.— The Independent Telephone Company at Ephrata will run a line from that place to this city.

THURMAN, IOWA.—McCartney Brothers have completed the line connecting Bartlett, McPaul, Thurman and Percival.

BORDENTOWN, N. J.— Prof. J. N. Clemmer, of Trenton, is endeavoring to organize an independent exchange in this city.

HAVANA, ILL.— E T. Munger, C. P. King and others have incorporated the Havana Telephone Company. The capital stock is $5,000.

ATLANTA, MO.— The Atlanta Telephone Company has been incorporated by H. H. Abbott, S. H. Nash and R. B. Turner. Capital, $2,700.

CHESTER, ILL.—A. S. Gordon, E. R. Gordon and C. Gordon have incorporated the Gordon Telephone Company, with a capital stock of $5,000.

AMARILLO, TEX.— A telephone line from here to Roswell, New Mexico, a distance of over two hundred miles, is being constructed by T. F. Moore & Co.

IRON CITY, TENN.— The Lawrence Telephone Company has been incorporated, and will give neighboring towns connection with Florence and Columbia.

MAGNOLIA, MISS. — The Citizens' Telephone Company has secured its franchise from the city and will commence to build a local and long-distance exchange.

MANKATO, MINN.— Blue Earth City and Mankato will soon be connected by telephone, if the arrangements between the companies in each city can be completed.

VINE GROVE, KY.— T. C. Vanmeter, D. Perwitt and others have incorporated the Winchester and Lexington Telephone Company, with a capital stock of $1,560.

CALDWELL, OHIO.—J. W. Hall, H. J. Hasley and J. L. Douglas have incorporated the Quaker City Telephone Company. A toll-line system will be installed.

WOODRUFF, S. C.— The Home Telephone Company has been granted a charter. E. P. Pearson is president, L. H. Irby, secretary, I. J. Workman, treasurer.

WILMINGTON, N. C.—A new company has been organized to construct telephone and electric light plants in the Southern States. Mr. J. M. Wood is general manager.

ROBY, TEX.— The Roby and Sweetwater telephone line has been purchased by Hughey, Green & McCrea, who will at once connect the line with Abilene and other points.

STAUNTON, VA.— The Staunton Company is the latest telephone exchange in this county. E. H. Eidelberger is president, G. S. Craig, secretary, and J. M. Krunkle, treasurer.

HENDERSON, KY.— The Henderson Telegraph & Telephone Company has been incorporated with a capital stock of $15,000, and will compete with the Cumberland Company.

YAZOO CITY, MISS.— The Silver Creek Telephone Company has been incorporated by R. M. Beaman, T. W. Fisher, J. P. Moore and others. The capital stock is $1,000.

LITTLE ROCK, ARK.—The American Telegraph & Telephone Company has been incorporated by C. H. Strong, G. Carroll, T. Busbee, and others. The capital stock is $10,000.

HELENA, ARK.— The recent action of the city council in fixing the rates for exchange service at $18 and $30 per year for residence and business service, respectively, is being fought bitterly by the Southwestern Telegraph & Telephone

Company, which claims the new rates are too low. The present rates are $36 and $48.

SALTILLO, PA. — The Huntingdon County Telephone Company, with a capital stock of $2,000, will establish telephone systems in Huntingdon, Bedford and other counties.

WHITE PLAINS, N. Y.— The Westchester Telephone Company's business has been steadily increasing of late, and the company is now located in its new exchange in the Rehill building.

JANESVILLE, WIS.—A new telephone company will soon be in operation here if F. D. Bill and E. L. Wortham, of Chicago, succeed in getting a sufficient number of local parties interested.

FREMONT, OHIO. — The Fremont Home Telephone Company has been granted a franchise to operate an opposition telephone exchange. Fremont and Tiffin capitalists are interested.

LEBANON, PA.—The People's Telephone Company, which was granted a franchise some time ago, has commenced work, and it is expected that the new exchange will soon be in operation.

SPARTANBURG, S. C.— The Citizens' Telephone Company has been granted a charter. H. W. Clark is president and C, E. Fleming manager and treasurer. The capital stock is placed at $32,000.

WEST UNION, VA.— The West Virginia Telephone Company is putting in an exchange at Parkersburg, West Virginia, from which place lines will be extended to Elizabeth and other points in the county.

WEST PLAINS, MO.— The Mountain Home & West Plains Telephone Company has been incorporated with a capital stock of $5,000, to construct a telephone system from Mountain Home to West Plains.

FRANKFORT, KY.— The Monticello and Jamestown Telegraph & Telephone Company has filed articles of incorporation. The capital stock is $3,000, and E. F. Moore, W. W. Rowe, and others are the incorporators.

CLINTON, IOWA.— A new 600-drop switchboard and some other improvements recently made by the Tri-City Telephone Company will give this city one of the finest and most efficient exchanges in the State.

ASHLAND, OHIO.— The Bell Telephone Company's plant is reported to have been sold to the Ashland Electric Light Company, which controls the Home Telephone Company. The Bell plant will be removed from the city.

CANAAN, CONN.— The Canaan Local Telephone Company has been incorporated. Of the $3,000 capital stock, $600 is paid in cash and $1,300 in property of the exchange owned by William Canfield, of New Marlboro, Massachusetts.

MENTOR, OHIO.— The Mentor Telephone Company has been incorporated by J. W. Lowe, C. Hogenberger and A. I. Ingersoll. The object is to operate a telephone line in Lake County. A capital stock of $25,000 has been subscribed.

UNIONTOWN, PA.— James Kuntz, A. W. Pollock and J. S. Bailey, and others, have organized the Washington County Telephone Company, to operate a telephone system in Washington, Greene and Allegheny Counties. The capital stock is $75,000.

TRAVERSE CITY, MICH.— The Northern Telephone Company, of Battle Creek, has applied to the city council for a franchise to operate an exchange. It asks for a thirty-year franchise, and proposes to fix the rental of 'phones at $24 per year for business houses and $12 for residences.

LEWISTON, ME.— William Williams, of Monmouth, is president and W. H. Brown, of Lewiston, treasurer of the Lewiston & Greene County Telephone Company, recently organized. The capital stock is $10,000. Lines will be operated in Androscoggin, Oxford, Cumberland and Kennebec counties.

WORTHINGTON, MINN.— The new telephone system recently contracted for by ex-Mayor Smallwood has been put in operation and is giving good satisfaction. A 100-line outfit, made by the Keystone Telephone Company, of Pittsburg, has been installed. Metallic circuits and long-distance instruments are used.

MONTHLY DIGEST OF TELEPHONE AND KINDRED PATENTS

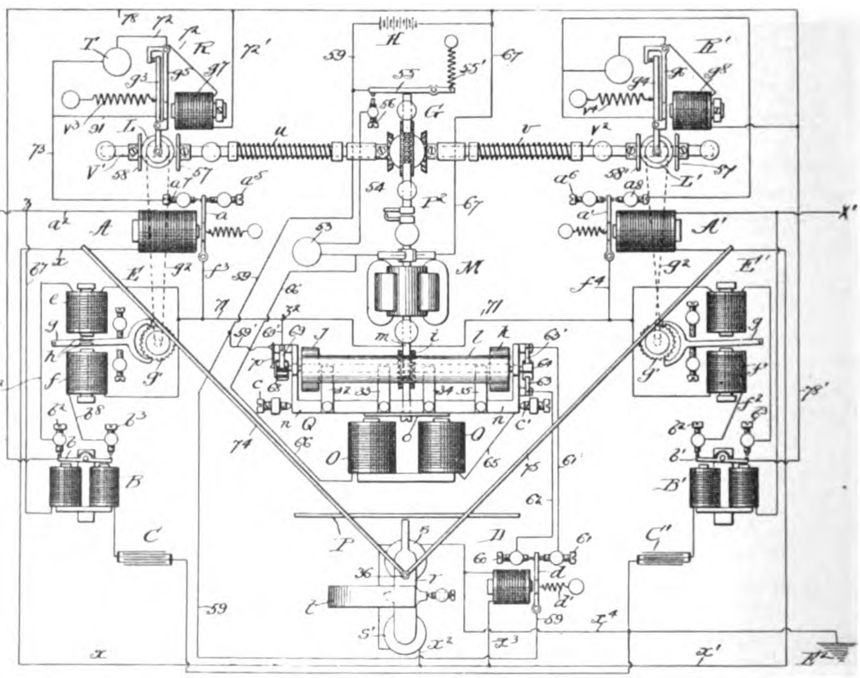
SPECIAL NOTICE!

Hereafter there will appear each month, under this heading, notices of patents issued during the preceding month for inventions relating to telephony or subjects kindred in interest, such as telegraphy. These notices will not be limited to such patents only, however, but will include other electrical patents if of sufficient interest. In each case a brief digest of the subject matter, and if necessary an illustration, will be given, but not the claims, and this for the reason that it is usually the invention and not the scope of a patent that interests practical men. The matter will be edited by Mr. Edward E. Clement, who for a number of years had direct charge of matters relating to telephony in the United States Patent Office. Interrogations on patent subjects should be addressed to him in the McGill building, Washington, D. C., or in care of this magazine. Copies of the patents may be had by inclosing 5 cents and postage for each one.

September 6.

610,274. — L. O. McPHERSON. TELAUTOGRAPH.

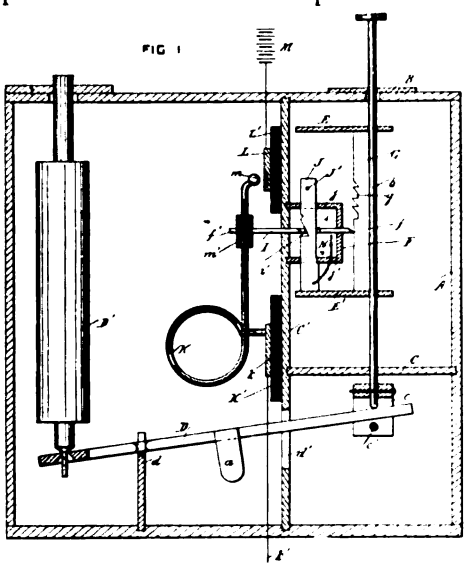
This invention relates particularly to that class of autographic-sign telegraphs wherein a recording pen is caused to trace upon a suitable surface characters in facsimile of and simultaneously with similar characters traced by the hand of the operator at a distant point, wherein the reproducing movement is a resultant of two forces acting at substantially right angles to each other upon a single point.



No. 610,274. TELAUTOGRAPH.

The invention is essentially an improvement on the constructions shown in patents to Gray, 491,346 and 491,347, and to McPherson, 585,319 and 587,013. The figure herewith represents the receiving station — 74 75 are the reciprocating pen-arms, carrying pen 36 (of the Gray type), controlled directly in their movements by the drums g'. The drums are driven by friction gears L L′ from shafts V′ V², which derive their motion through bevel gears G and shaft m from motor M. Magnets R R′ throw

the friction gears L L′ over to one side or the other to reverse motion. Motor M drives worm wheel *i* on transverse shaft carrying friction rollers *j k*. Paper feed and roll *l* is mounted on brass frame *n* pivoted at *c c′* so as to oscillate to and from rollers *j k*. Magnet O pulls the frame down at proper time to permit paper to engage rolls *j k* and be fed a space. X X′ are the incoming line wires. All mechanism is controlled over these two wires only and the ground by a combination of plain and polarized relays. To increase the combinations, possible condensers and impedance coils



No. 610,278. TELEGRAM TRANSMITTER.

are used, whereby added effects may be produced.

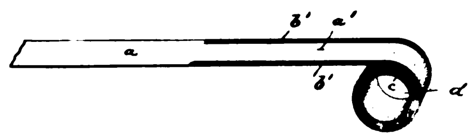
The transmitter and receiver are intended to be combined in the same instrument. The former is similar in general appearance to the latter, having arms and a pen, but drums frictionally turned by arms to oscillate contacts in place of parts *g g′*. A master switch is also added to control the sending battery. A movable platen effects the first change by pressure on circuit-closing lever. One salient feature is the use of magnetic rock levers or anchors for circuit closers, which cause their contact arms to jump quickly from one contact to another when one or the other magnetic extremity is approached by moving operative parts. This improvement is applied particularly to the Prony brake, so as to enable its control over the two-wire circuit.

610,278.—E. PORTER. TELEGRAM TRANSMITTER.

This is a keyboard transmitter having a series of vertical key rods *b*, each carrying a code plate G, notched in accordance with the Morse or other code to represent a letter or numeral. A contact spring K is alternately lifted and depressed through the agency of a rod I by the notches in the code plate. A stop-plate holds the rod I inactive until the key rod is fully returned.

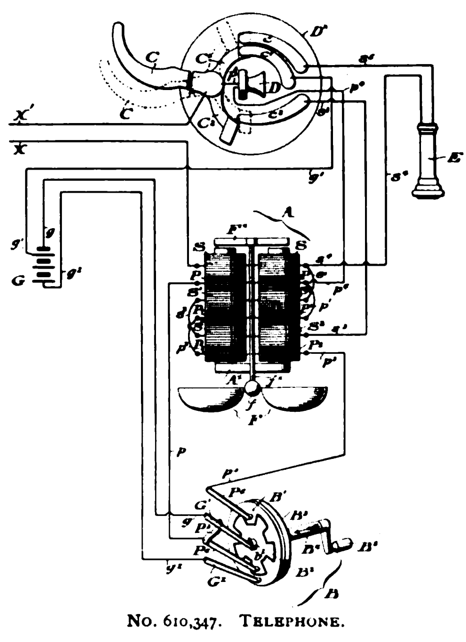
610,339.—F. ATHERTON. TELEGRAPH TAPE.

This invention is a telegraph tape—that is, a message-receiving tape—with marks or indications to call the operator's attention to the fact that the end of the coil of tape is approaching. The



No. 610,339. TELEGRAPH TAPE.

patentee colors the edges of the tape for some distance from the inner end.



No. 610,347. TELEPHONE.

610,347.—W. A. DRYSDALE. TELEPHONE.

This is for an improved desk telephone set. The main idea is to economize space, and to this end the ringer, the generator and the induction coil are combined in one piece of apparatus A, having several windings. The cores, when properly energized by one pair of windings, are fitted to work an ordinary ringer armature, while other windings serve as primary and secondary for the talking circuit, and as primary and secondary of a transformer for sending calling currents. In connection with this last a rotary pole changer B is used. The ringer and pole changer are both housed in the base of the instrument, while the usual hook switch is provided, but working on and with its contacts located in the transmitter shell.

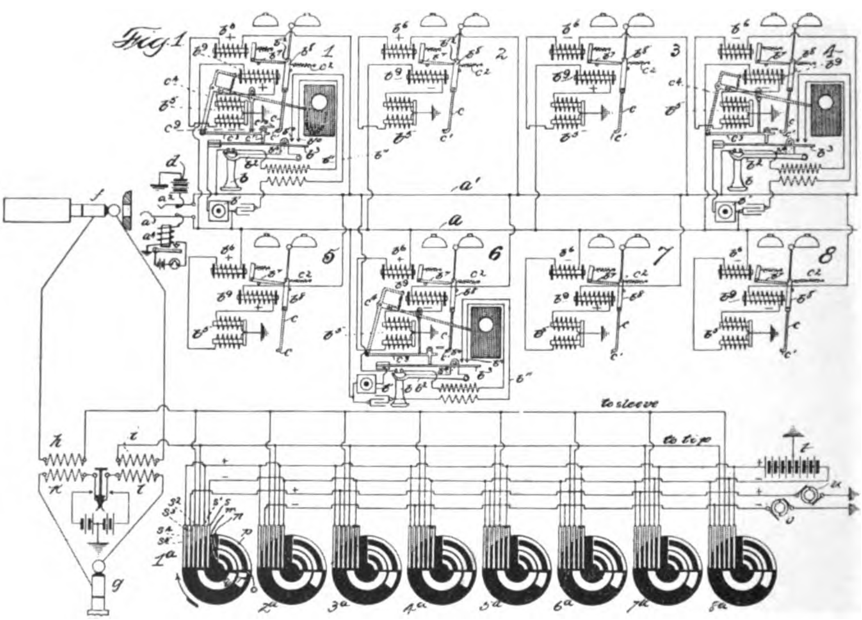
610,393.—S. S. FISHER. TELEPHONE.

This is a simple telephone system provided with push buttons and manual switches for throwing battery current on the line either way to work relays which close the bell circuits. When the switches are both thrown over the talking sets are both cut in.

September 13.

610,704.—W. W. DEAN. TELEPHONE SYSTEM.

The invention disclosed in this patent is a lockout party-line system, with subscribers' busy signals. It forms one of an important series in which Mr. C. E. Scribner and several others are represented. The basic idea is to provide each of the subscribers (in this case eight) on a party line with apparatus which will apprise him of the fact that the line is in use, and at the same time lock his switching apparatus so that he cannot disregard the signal and break in. This is accomplished by means of a pair of polarized magnets at each station connected respectively to the two sides of line and to ground. A third magnet has two windings, one of which is in series with each of the polarized magnets, the ground tap being taken off between its windings. The armatures of the three magnets are ingeniously arranged to interlock, that of the second magnet carrying the bell clapper, and that of the third carrying the busy signal. The first polarized magnet responds to direct currents and the second to pulsating cur-



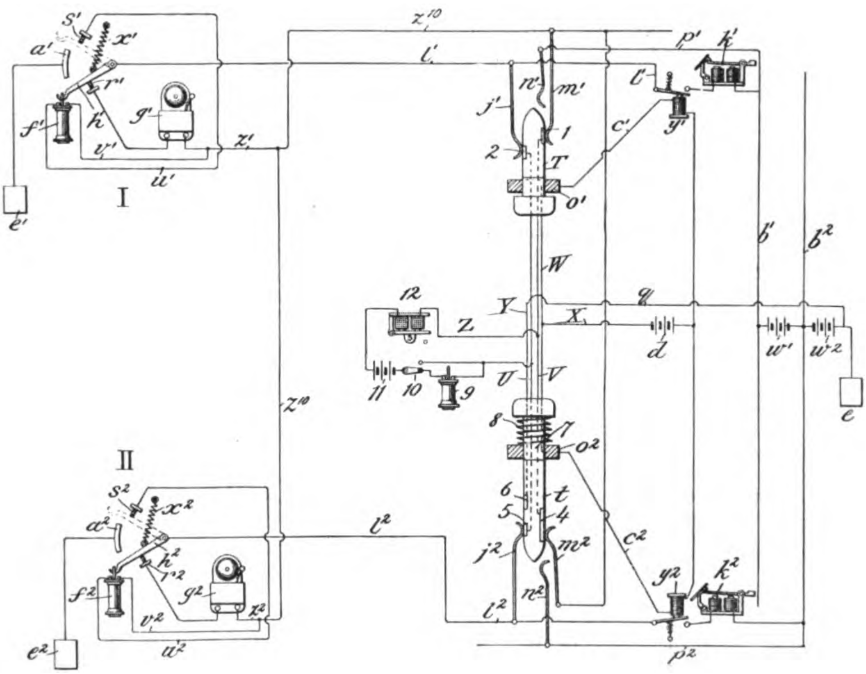
NO. 610,704. TELEPHONE SYSTEM.

rents, only. Obviously it is necessary to send the proper combination of currents to line to unlock the apparatus at a given station. In order to do this, and to maintain the same so that the subscriber can answer after the operator has ceased calling, without finding his apparatus again locked, a cylinder with a series of switch contacts and a corresponding series of springs is provided for each plug cord circuit. The operator merely sets the cylinder for the station desired, and plugs in. The proper generators and battery are connected to the various springs so that the desired currents flow out to line without further attention until the call has been answered. A striking feature of the subscriber's set is the hook lever, which only engages the spring switch when down, i.e., when the telephone is hung up. When it rises it simply disengages the spring, and if the latter has been unlocked it follows. By this construction the hook can be tampered with to any extent without affecting the rest of the apparatus at all.

September 27.

611,581.—G. RITTER. TELEPHONE SYSTEM.

This is a common battery calling system. The subscriber's hook switch in rising momentarily closes one side of line to ground, thus completing circuit at central through line drop and main battery. When answering plug T is inserted, a local circuit is closed at the jack frame to a disabling relay Y′, which breaks the line drop connection. The calling plug *t* has a spring which, when inserted, allows it to be pushed completely into the jack to bridge the calling battery and line contacts, but when pressure is removed partly withdraws it to again connect with line springs alone.



No. 611,581. TELEPHONE SYSTEM.

TRADE NOTES.

CATALOGUE No. 112, recently issued by the Atlas Engine Works, Indianapolis, is devoted exclusively to a description of the several types of electric-service engines made by the company. The book gives a complete list and excellent illustrations of each type, from the small Automatic Self-Contained to

the Double-Expansion (Tandem) Cycloidal Heavy-Duty engine, direct-connected to a generator. The booklet is prepared in a most artistic and elaborate manner, and its appearance accords well with the high character of the machinery described.

AMERICAN BATTERY COMPANY, Chicago, recently furnished some 600-ampere-hour and some 1,600-ampere-hour cells to the Chicago Telephone Company. The American Company reports the application of storage batteries for use around telephone exchanges as fast becoming recognized as the most economical method of furnishing current.

WICKES BROTHERS, the well-known builders of stationary and marine steam boilers, of Saginaw, Michigan, have found it necessary to open a Chicago office in order to take better care of the increasing business. Mr. W. S. Huyette, the company's contracting engineer, has been placed in charge of the offices, 1214 Marquette building, where he will no doubt meet with well-deserved success.

WESTERN ELECTRIC COMPANY, Chicago, is constantly adding to its already large line of the smaller tools that go to complete the lineman or wireman's outfit. The Eureka blowpipe, described in a little circular recently issued by the company, is a very convenient and durable tool. It is especially adapted for soldering, light brazing, heating soldering irons, and should be in the toolroom of every telephone exchange.

Electrical Engineering And Telephone Magazine

CONTENTS OF THIS NUMBER.

THE "CONTINENTAL LIMITED" VIA THE

WABASH

A HANDSOME NEW THROUGH TRAIN DINING CARS

LEAVE CHICAGO, 12:02 NOON.
ARRIVE DETROIT, 8:20 P. M. SAME DAY.
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Minnesota,	Tennessee,
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Wisconsin,	Mississippi,
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Presenting an unequaled territory for diversified industries, and possessing

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To sound industries, substantial inducements will be given by many of the places concisely described in the pamphlet "100 Cities and Towns Wanting Industries." Write for a copy. Nearly all kinds of industries are wanted. Very liberal inducements are offered **TEXTILE INDUSTRIES** in the South by a number of good places.

GEORGE C. POWER,
Industrial Commissioner, I. C. R. R. Co., Chicago.

P. C. BURNS, Treas.

Laclede Carbon & Electric Co.

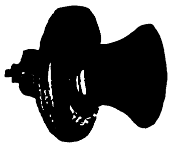
Manufacturers of

GLASS, CARBON and PORCELAIN....

Electrical Supplies

....KOKOMO, IND.

Facsimile of Diploma with Bronze Medal awarded ELECTRICAL ENGINEERING for Specimens of Printing and Bookmaking, Brussels International Exposition, 1897.



TRANSMITTERS...

STRONG AND DURABLE.

Sealed to prevent opening and deranging of parts by inexperienced persons.

SWITCHBOARDS.

S.-C.

INTERCOMMUNICATING SYSTEM

For HOTELS, APARTMENT HOUSES, RESIDENCES, OFFICE BUILDINGS, MANUFACTURING PLANTS, PUBLIC INSTITUTIONS, MILLS, MINES, ETC.

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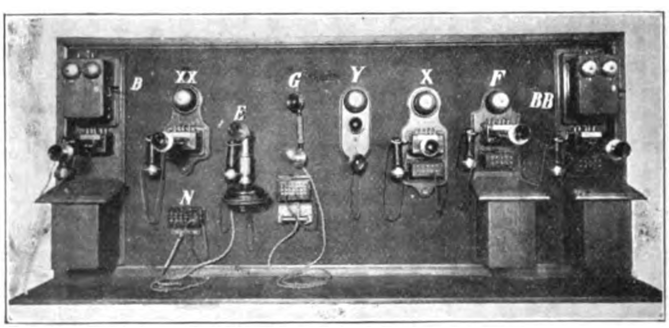

A1 Goods. Fully Guaranteed. Strong and Durable. Adapted to all Purposes.

SPECIAL INDUCEMENTS TO EXCHANGES OR MANAGERS.

Write for Circular.

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PRIVATE PLANT TELEPHONE SYSTEM.

CENTRAL STATION AND INTERCOMMUNICATING.

See next announcement for Latest Type Switchboards.

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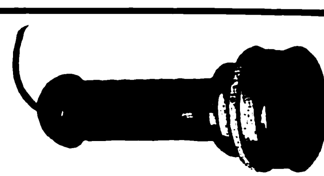

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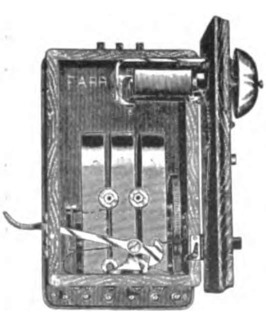

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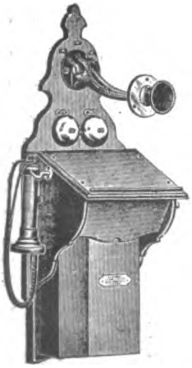

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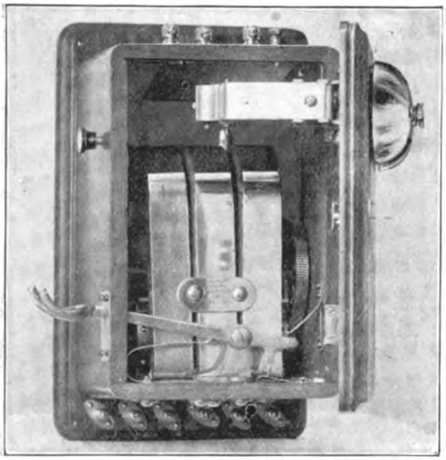

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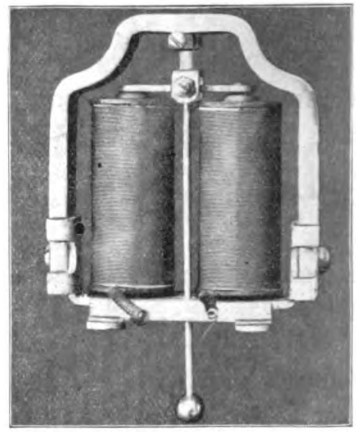

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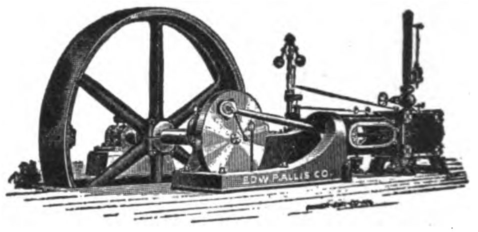

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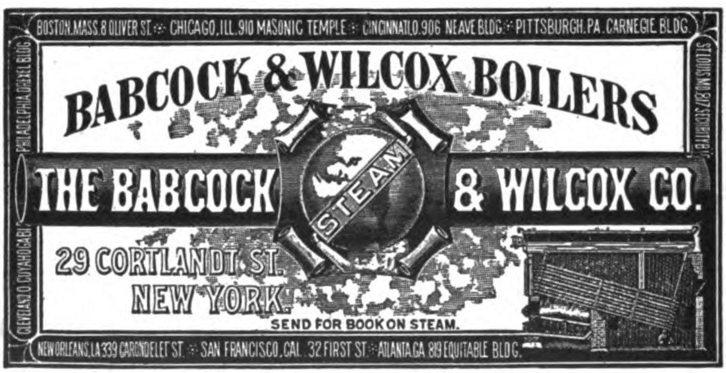

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VOL. XII. CHICAGO, NOVEMBER, 1898. NO. 86.

PARTY LINES.

IV.—BY KEMPSTER B. MILLER, M.E.

STRENGTH AND POLARITY SYSTEMS.

The term "strength and polarity" is borrowed from the Patent Office nomenclature, where it is applied to that class of selective calling devices which depend for their operation on changes in the strength or in the direction of a current, or on changes in both. The idea of selective signaling by changes in the strength and polarity of a current was well known in telegraphy before the birth of the art of telephony. The duplex and quadruplex systems of telegraphy of the present time afford the best possible demonstration of the utility and practicability of this system when properly developed. In the quadruplex, one key at each station operates to produce changes only in the strength of the current, while the other key at each station is capable of producing changes only in the direction of the current. Also at each station are two relays, one termed the "neutral relay," responsive to changes only in the current strength, being indifferent to changes in polarity, and the other termed the "polarized or polar relay," which is responsive to changes in the direction of the current only, being indifferent as to its strength. The arrangement is such that the key at one station governing the strength of current will operate only the neutral relay at the other station, while the key governing the direction of current will operate only the polarized relay at the other station. This system, therefore, not only admits of selective signals being sent one at a time, but also allows four to be transmitted simultaneously over a single grounded circuit, two in one direction and two in the other.

The problem is somewhat different in telephone work, but the same principles are involved, and the success of the quadruplex telegraph demonstrates beyond question that the strength and polarity system can be made thoroughly practical in telephony. At present, nearly all of the party lines successfully using selective signaling are operated on this general plan.

Among the first to attack the problem from this standpoint was George L. Anders, who in 1879 produced a two-party line system, having the call bells at the two stations polarized oppositely, and included serially in the line wire. Currents in a positive direction would therefore operate the bell at one station, and those in a negative direction that at the other. The call bell was arranged with two armatures, one polarized and one neutral, the latter serving to operate the bell striker, and the former serving simply as a lock for the striking armature. The bell would operate only when the current was of proper direction to cause the magnet to remove the locking armature from the path of the striking armature. The operator at the

central station used a double lever key to send either positive or negative calling currents to line. This was the forerunner of several more successful plans recently devised.

The system shown in Fig. 1 is interesting as being one of the early attempts to utilize changes of both strength and polarity. It is typical of many of the early failures in this line of work, and is not here described because of any practical ideas it contains.

Eight stations are connected in series in the line, which is adapted to be grounded at central through the various keys and batteries as shown. Each of the controlling magnets consists of a permanent horseshoe magnet carrying soft iron pole pieces and bobbins. The armature of each magnet is normally attracted by the permanent magnetism, and thus holds open a local circuit, shown only at the first station, containing a battery and bell at each station. The magnets at stations 1 and 2 exert an equal pull on their armatures but are of opposite polarity, and likewise the two magnets in each other pair of stations are of equal strength but of opposite polarity. The strength of the magnets is, however, different for each successive pair of stations — those at stations 1 and 2 being the weakest, and those at stations 7 and 8 the strongest. Four different strengths of current of either polarity may be sent to line from central by the closure of the various switches. The magnet at any given station is supposed to release its armature only when a current of the proper strength and direction is sent over the line to exactly neutralize its permanent magnet. Thus, if it is desired to call station 1, switch lever 1 at central is closed. This sends a positive current from one set of cells over the line which is of the proper strength and direction to neutralize the pull of the magnet at station 1. This magnet will therefore release its armature. The armature at station 2 will not be released, because the current is in the wrong direction, and therefore strengthens the pull of the magnet. The armatures at the other stations will not be released, because the current is not strong enough. In call-

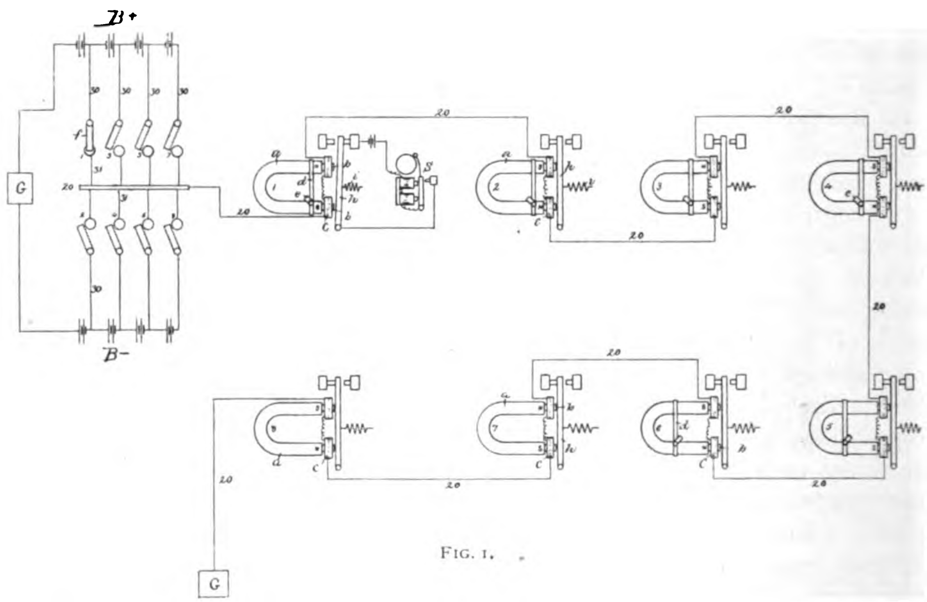
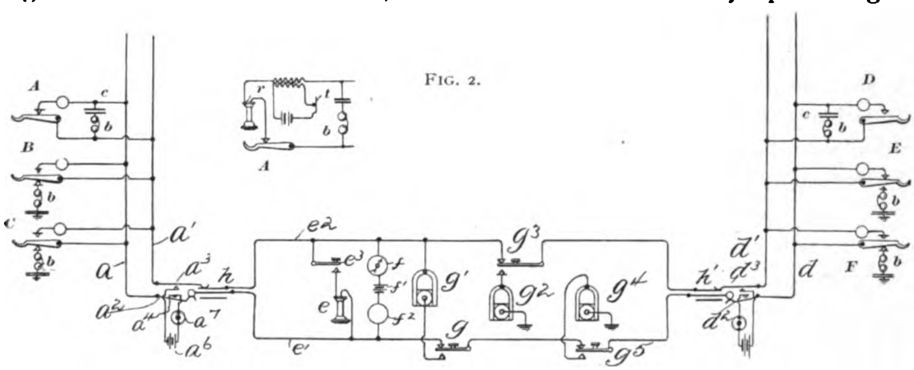


FIG. 1.

ing, say station 8, a strong negative current would be employed. This would more than neutralize the magnets of stations 2, 4 and 6, giving them an opposite polarity, and thus still attracting their armatures.

Coming now to the more practical systems, one due to Sabin and Hampton, and used to some extent on the Pacific coast, will be considered. This is not properly a strength and polarity system, but is described in this place because it contains several ideas upon which later systems have been based. The idea upon which this is based is that three circuits may be obtained from the two wires of a metallic circuit by using the two wires for one circuit, one

Fig. 2.



of the wires and the ground return for another, and the other wire and ground for the third. In Fig. 2, two party lines of three stations each are shown connected through a cord circuit and the jacks and plugs of a switchboard at the central office. The circuits of one station are shown in the small detached portion of this figure. Between the two limbs of the metallic circuit are included the talking apparatus, composed of the transmitter t and receiver r, associated with the induction coil, battery and switch hook in the ordinary manner. The talking circuits at all of the stations are the same as this, but are represented merely by a circle in each station. The bell b of subscriber A is included with a condenser in a bridge circuit between the two sides of the line, the bell b of subscriber B is included in a branch between the side a' of the line and ground, while the bell b of subscriber C is similarly included between the other side, a, of the line and ground. The bells of stations D, E and F on line $d\ d'$ are similarly arranged.

The limbs $a\ a'$ of the metallic circuit extend to the line springs $a^2\ a^3$ of a spring jack on the switchboard, which normally rest against the contact anvils $a^4\ a^5$ between which are included the battery a^6 and indicator or annunciator a^7.

The operator's telephone set e is included in a normally open bridge between the tip and sleeve strands $e'\ e^2$ of the cord, a key e^3 being provided for bridging the telephone into circuit. A clearing-out indicator f and battery f' are included in a bridge between the two strands, a balancing coil f^2 being also located in said bridge. By means of a key g, a generator g' may be bridged between the strands e' and e^2, the generator g^2, by means of a key g^3 may be connected between the sleeve strand e^2 and ground, while the generator g^4, by means of the key g^5 may be similarly connected between the tip strand e' and ground.

Suppose subscriber A desires to converse with subscriber D. He removes

his telephone from its hook, thus completing the circuit of battery a^6 through indicator a^7 and thus calling the attention of the operator, who inserts answering plug h in the spring jack, thereby cutting out battery a^6 and indicator a^7. The operator then depresses the key e^1, thus bridging her telephone into circuit and receives the number of the called subscriber D. She then inserts calling plug h' in the spring jack in which the limbs d d' terminate, and depresses key g, thus sending a calling current from the generator g' over the metallic circuit to actuate the bell b at station D. Subscriber D removes his telephone from its hook and A and D are connected for conversation.

Had A desired connection with F instead of D, the operator would have depressed key g^5, thus ringing the bell b at station F over a circuit formed by the line wire d with ground return.

The condensers c at stations A and D are for the purpose of preventing the steady current from battery a^6 from leaking through the bridges in which the bells b at those stations are placed. These condensers form a break in these bridges through which an unvarying current cannot pass, but they allow the alternating currents from the calling generator to act inductively through them to operate the bells as though they were not present.

Where three stations are thus operated on a metallic circuit, much trouble occurs, due to the fact that the two bells on a line at the stations which are not being called are always in series in a circuit which forms a shunt to the bell at the station which is to be called. Thus if a generator current is sent over the metallic circuit to call station A, a part of this current will leak from limb a' through bell b at station B to ground, thence to ground at station C and through the bell b at that station to the other limb a of the line. This bridge circuit has about twice the resistance of the bridge at A (disregarding the condenser), and this fact must be depended upon to prevent the bells at B and C from ringing. The same conditions exist in ringing either of the other bells, and this difficulty has rendered the use of three stations on a line, according to this method, impracticable save in rare cases, as it is very difficult to so adjust the bells that they will respond only at the proper times. Two stations on a line, arranged as at B and C, may, however, and often do, give good service. On long lines, however, there is sometimes enough induction between the two wires of the metallic circuit to cause both bells to ring when only one is intended to respond.

A very successful four-station party line system devised by Mr. Angus S. Hibbard is shown in Fig. 3. In this system, as in several others, the idea first used by Anders, of placing two oppositely polarized bells on a single line, has been combined with that of Sabin and Hampton, just described, of ringing over different circuits formed by using the separate limits of the line with a ground return.

At stations A and B polarized bells d and d' are connected between the limb a of the line wire and ground. The bell at A is so polarized as to be operated only by currents sent over the limb a in one direction, while the bell at B will respond for a similar reason only to currents in the same limb in the opposite direction. In like manner, the bells e and e', at stations C and D, are oppositely polarized and connected between the limb a' and ground, so that bell e will respond to current sent over line a' in one direction, while the other bell e' will respond to current over the same

wire in the opposite direction. Thus, any one of the four stations may be called alone by sending the current in proper direction over one of the two wires.

The line terminates at the central station in a spring jack f composed of line springs f' and f^2 normally resting against anvils, connected respectively to a battery B′ and signal indicator S in substantially the same manner as in the Sabin and Hampton system. In this case, however, the signal indicator is an incandescent lamp adapted to be lighted by current from the battery B′ when the receiver at any station on the line is removed from its hook.

Four ringing keys, 1, 2, 3 and 4, are associated with the plugs g and g' in such manner as to enable the operator to connect the terminal of either of two grounded generators o and p with either the tip or sleeve strand of the cord, and therefore with either side a' or a of the line into the jack of which plug g is inserted. The generators o and p have opposite poles grounded, and we will say generator o is adapted to send positive impulses to line, and generator p negative ones.

When it is desired to ring the bell at station A key No. 1 is depressed, thus closing the circuit of generator o through contact h^5, spring h', sleeve-strand g^2, plug g, spring f^2, limb a, bell d to ground and back to the generator. A portion of the current also passes through bell d' to ground, but as this bell is polarized to respond only to negative currents it remains irresponsive. Should it be desired to ring the bell at substation B, key No. 2 is depressed, thus sending a negative current from generator p, to line a through k^5, k', h^2, h', strand g^2, and by the same path as before through bells d and d' to ground. Only bell d' will operate because d is responsive only to positive currents. Should it be desired to ring the bell at substation C, key No. 3 is depressed, while if it is desired to

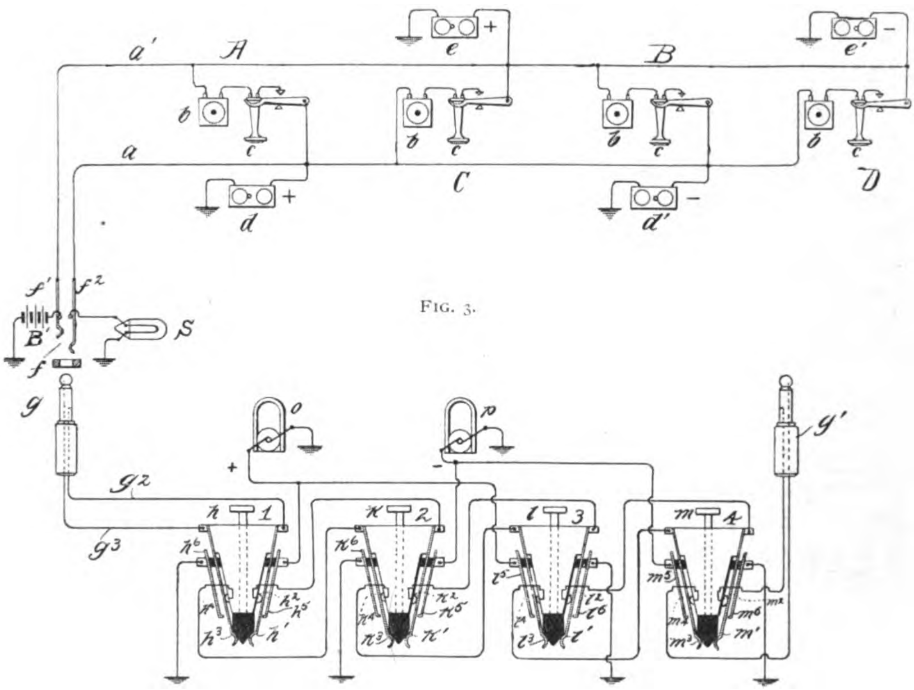


FIG. 3.

ring the bell at substation D, key No. 4 is depressed.

When the key No. 1, for instance, is depressed to connect the generator *o* in circuit with the limb *a* and ring the bell *d*, the spring h^1 is brought into engagement with grounded contact h^6, thus grounding the strand g^3 and the limb a' and preventing the accidental ringing of the bell *e*, should, for instance, one of the telephone-receivers be removed from its hook and a path thus provided to the limb a'. The current thus finds a short path to ground over the limb a', strand g^3 and grounded spring h^6, and sufficient current will, therefore, not pass through the bell *e* to ring it.

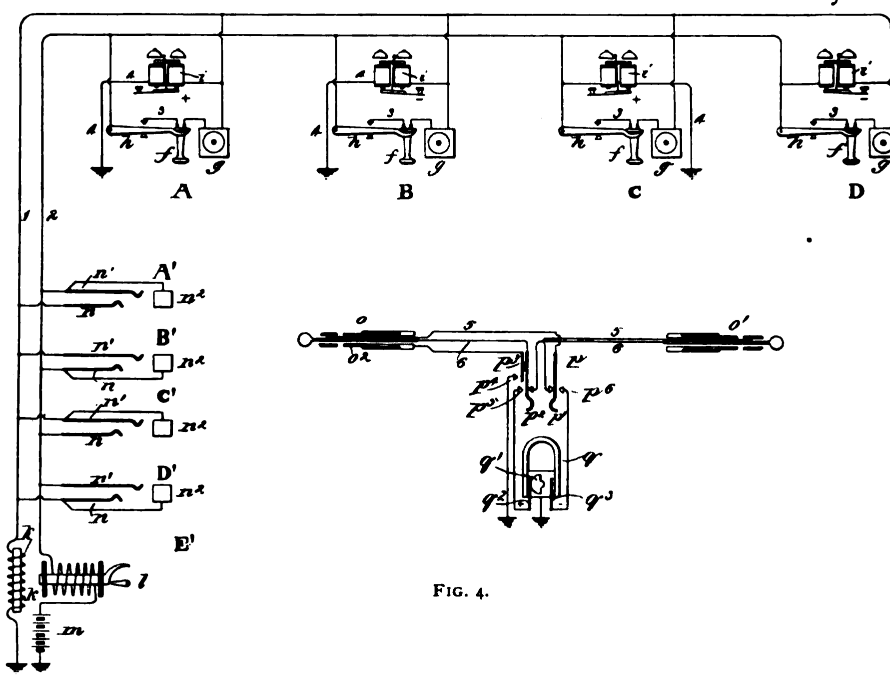


FIG. 4.

Instead of providing four keys in each cord set, a single set of keys is usually provided, adapted to be connected by a suitable switch with any particular pair of cord conductors that may be for the time in use.

This system with slight modifications is used in a number of Bell exchanges and apparently is a success. The practice of putting the lamp signal directly in the line circuit has, however, not proven very satisfactory, even in cases where a separate metallic circuit serves each subscriber. Accidental crosses or grounds on the line expose the lamps to higher voltages than intended, thus frequently causing burn-outs. On party lines another difficulty arises, due to the difference in the resistance of the circuit when closed at the different stations, owing to the resistance of the line wire between the stations. Obviously the circuit formed by removing the receiver at A is of less resistance and will therefore expose the lamp to a greater voltage than that formed by removing the receiver at D. This, however, could be compensated for by winding the receivers of the nearer stations higher than those at the farther, or by inserting compensating resistance coils.

Another system using exactly the same method of selective signaling, but employing a very ingenious arrangement of apparatus for carrying it out, is one

devised by Mr. F. R. McBerty, of the Western Electric Company. This is shown in Fig. 4. The bells at each of the stations and also the talking apparatus are arranged with respect to the two wires of the metallic circuit in precisely the same way as in Hibbard's system. As a safeguard to prevent the bells ringing by the wrong direction of current, a light spring acts on the pivoted armature of each to retain the armature normally in the position toward which it would be attracted by a current in a direction not intended to operate the bell. The operation of signaling central is identical with that already explained.

In connection with the line conductors 1 2 are four spring jacks, A′, B′, C′ and D′. Each of these has a short line-spring n, a long spring n', and a tubular thimble n^2. The connection of these springs and thimbles to the conductors of the line is different in the case of each jack, as examination will readily show.

The switchboard is provided with the usual plugs o o', forming the terminals of a plug-circuit 5 6, which includes a calling key p. This key p, in addition to the pair of switch springs p' p^2 and their normal and alternate contact anvils, has a spring p^3, which is adapted to register with an anvil p^4 when the spring is thrust outward. The spring p^3 constitutes the terminal of a contact piece o^2 of the calling plug o, which is constructed to register with the ring n^2 of a spring jack into which the plug may be inserted. The anvils p^5 p^6 of springs p' and p^7 constitute the terminals of a generator q of alternating currents. This generator is due to Scribner, and is of peculiar construction. It has an armature of the ordinary type, one of whose terminals is grounded permanently, and the other of whose terminals is led to a semicylindrical commutator q', which rotates between two contact springs q^2 and q^3. These springs are so placed with relation to the point at which the direction of the current in the armature is changed that spring q^2 receives in each revolution a pulsation of positively directed current, and the spring q^3 during the other half of the revolution a negatively directed pulsation. The operation of the key p therefore always connects the positive spring of the generator with the tip strand 6, the negative spring with the sleeve strand 5, and at the same time connects the plug contact o^2 with the ground. The arrangements of the jacks with respect to the line wires are such that the mere insertion of the plug o in any jack will establish the proper relations between the generator and the line, to operate the bell at the corresponding station upon the depression of key p. Thus suppose the operator wishes to call station A. She inserts the plug in jack A′ of that line, and depresses key p. A pulsatory current in a positive direction will now flow from the spring q^2 through the contact points p^5 p^2, thence through conductor 6 of the plug circuit to line conductor 1, and thence through branch 4 and bell i at station A to ground. The bell will be operated by this current. The bell at station B will also receive part of this current, but not be operated on account of its polarity. A pulsatory current, whose pulsations occur in the intermissions of current through spring q^2, and of opposite direction, will flow out from spring q^3 through conductor 5 of the plug circuit to spring n'; but from this point a short circuit is provided through the thimble n^2 to the contact piece o^2 of the plug, and thence through the contacts p^3 p^4 of the key to earth. Hence no signaling current will reach the line conductor 2, and the operation of the bell at station D will be prevented.

By tracing out the circuits through

the other jacks it will be found that in each case the spring jack into which the plug is inserted determines the signal connected with that line which shall be operated.

When the operator has made a connection with any spring jack, and has operated the signal at the corresponding station, the presence of the plug *o* in that spring jack indicates to her, during the existence of the connection, the station which has been signaled. If it should be necessary to signal the same station again, she does not have to remember which party on that line has been signaled, for she may be sure of again calling the same one by merely pressing the key *p*. If it should be necessary to make any charge, as in the case of a toll connection, the identity of the station signaled is ascertained by the presence of the connecting plug in the corresponding spring jack.

(To be continued.)

A SUCCESSFUL INDEPENDENT EXCHANGE.

It was in the year 1893 that the telephone situation at Lafayette, Indiana, through a combination of circumstances, attracted the attention of investors. The passage of the Indiana telephone law some years prior, regulating the rates, the evasion of the law under every technical point conceivable, the repeal of the law, and the enforcement of execrable service at an extortionate rate upon a long-suffering community by the Bell Telephone Company, caused a meeting of the citizens of Lafayette to be called in September, 1893. It was unanimously agreed that an independent company be incorporated.

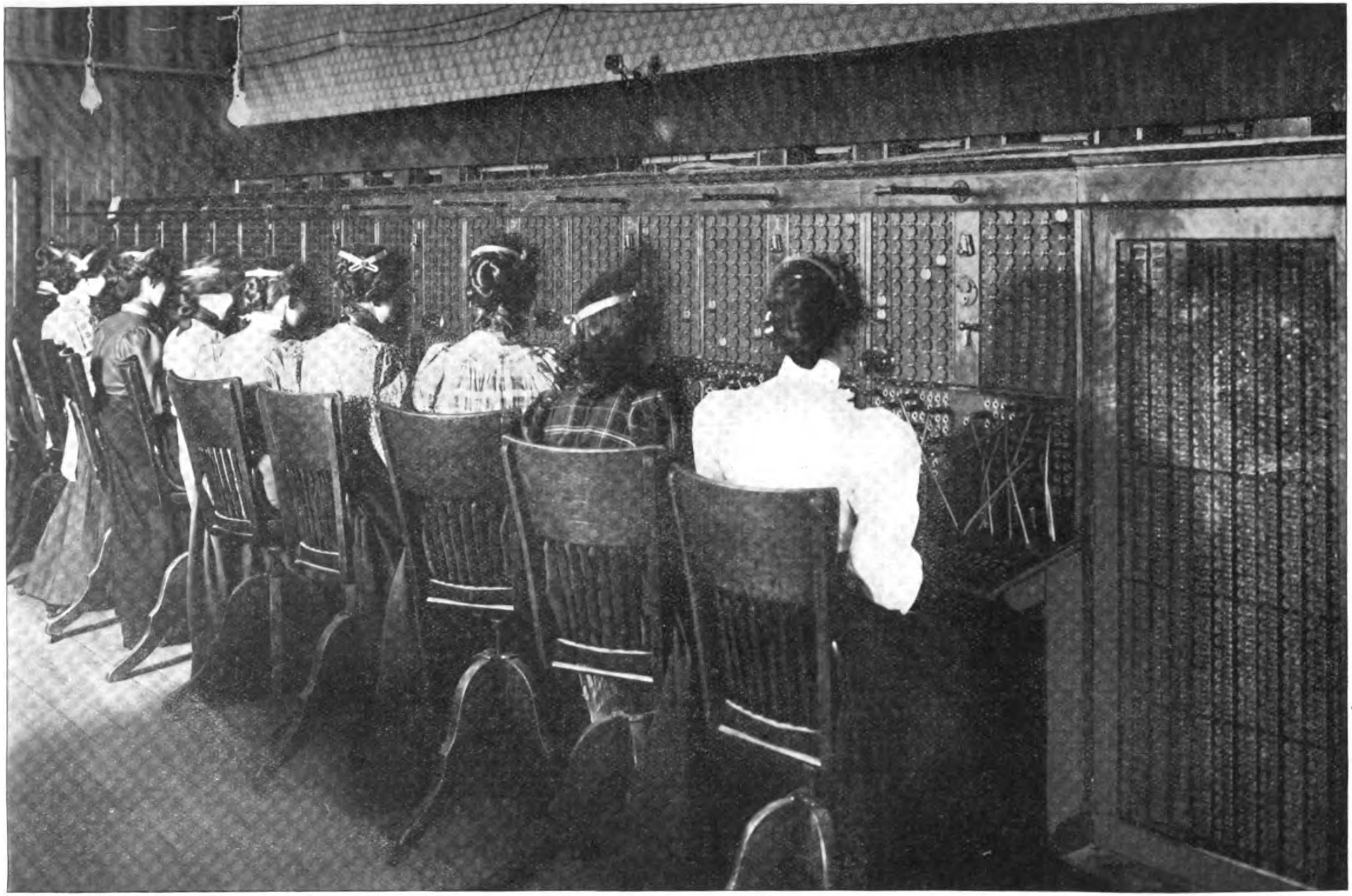
Officers were named and active soliciting commenced at once. The construction of this plant began in October, 1893, the exchange being opened for service February 15, 1894, and the company, incorporated under the name of the "Lafayette Harrison Telephone Company," installed the Harrison telephones and switchboards, which were the best obtainable at that time.

At the time of the opening of the Harrison Company's exchange the Bell Company had in operation 250 instruments, at rates ranging from $48 to $102 per annum for business places, and $36 to $72 for residences. The Bell Company also rebuilt their exchange throughout the moment the Harrison Company commenced work, not leaving one particle of any material in the plant, thus placing itself in the best possible shape to give good service. The long-suffering public, however, did not greet the Bell Company's improvements with favor, as there was relief at hand from another source, the Harrison Company.

March 1, 1894, the Harrison Company commenced collecting rental with 402 subscribers in service at a flat rate of $30 per annum for business places and $18 for residences, the Bell Company cutting its rate at this time to $18 per annum for business places and $12 for residences. The Harrison Company did not meet the cut, however, but sustained its rates as regulated by its franchise.

During the year 1894 the Harrison Company's exchange grew to 550 subscribers. The Bell Company, with four solicitors, cheap rates, and in many cases free service, began losing ground. In 1895 the Harrison Company increased to 625 subscribers, the Bell crawling back to 250 by means of free service offerings. In 1896 the Harrison Company had increased to 728 subscribers, and had established a complete network of toll lines, the Bell Company increasing to about 333 in number, having thoroughly worked the public on its party line scheme, offering free service for from three to eighteen months to anyone who would permit them to run wires to his house.

In 1897 the Harrison Company showed a list of 850 subscribers, as against a claimed service of 400 'phones by the Bell Company; while at the present, in 1898, the Harrison Company is serving over 1,000 subscribers and 300 toll stations, as against less than 500 subscribers claimed by the Bell Company, which with all its guerilla tactics, free service, etc.,



OPERATING ROOM, LAFAYETTE HARRISON EXCHANGE.

has been able to serve only the least desirable portion of the community.

During these years the Harrison Company had been keeping apace with the times as better material and apparatus came upon the market. The instruments were all worked over, changing the transmitter, changing the form of the receiver, and changing from the manual to the gravity hook.

In 1896 the service was becoming too extensive to be handled upon the Harrison apparatus. At this time the switchboard was equipped with the Beach-Cook Automatic Transfer System, and the cable poles equipped with pole top cable terminals (both of which are now manufactured by the Sterling Electric Company, of Chicago). These changes and additions made a marked improvement in the service, and made it possible for the company to continue its growth with the apparatus in use, as there seemed to be nothing better upon the market.

In September, 1898, the list of subscribers having reached 1,000, the Harrison Company felt that it had outgrown its original exchange equipment, and, as it was now able to secure the same kind of central office equipment as the Bell Company, a point which, with its four years' actual experience with difficult apparatus, was all-important and vital, it refitted its entire central office or exchange with a complete equipment of the Sterling Electric Company, of Chicago, this company installing switchboards, distributing boards, cable terminals and protectors, with a capacity of 1,000 pairs of wires. The installation of this apparatus made such a marked improvement in the service that it has caused a regular flood of new patrons, necessitating the Harrison Company to place an order at once with the Sterling Electric Company for additional apparatus.

At the time of changing the central office equipment, the Harrison Company commenced changing its instruments, purchasing the different parts and assembling the same, using a high-wound bell and changing these instruments at the rate of about one hundred a month. When the change is completed the Harrison Company will have one of the most perfect working exchanges in the independent field, and give service of the highest efficiency.

The Bell Company's claim that the love of the almighty dollar will finally carry the public back to its fold, does not hold good. For a period of five years it has been giving free service to any and all, operating on an $18 and $12 rate, conducting a guerilla warfare that has no precedent in the history of business among business institutions, and has succeeded in printing a list with upward of 500 names thereon, its business having been run at a heavy loss every minute of this period; while the Lafayette Harrison Company, during the same time, starting with a uniform rate of $30 and $18 and sustaining it, has grown from 400 to 1,000, has conducted its business on business principles, has earned and gained the confidence and hearty support of the entire community, has received handsome returns upon its investment, and has demonstrated to the public at large the practicability of independent telephone companies.

At the end of a five years' career, during which entire time the Bell Company has furnished free service more or less, the Harrison Company charging $30 and $18, we find the Harrison Company unable to supply the demand for service.

This does not look as if public opinion can always be changed by the glitter of monopoly's gold.

This very successful exchange thoroughly demonstrates and proves the wisdom of investors in entering the independent telephone field, as these properties, when judiciously handled, offer the best of returns to the investor.

EATON, OHIO.— The necessary capital for a line from Eaton to Oxford has been subscribed, and work will be commenced at once.

A CONTRACT for a 2,000-line express switchboard has just been secured by the American Electric Telephone Company, to be placed in the exchange at Lancaster, Pennsylvania. The board is to be built on the same lines as the boards recently furnished for the Trenton (N. J.) exchanges.

LINE INSULATORS.

BY F. A. C. PERRINE, D.Sc.

In the discussion of the pole line we have considered only the mechanical features, our attention having been devoted to the study of the best means for maintaining wires in position where they will be permanent under all atmospheric conditions, and where they will be reasonably free from all interference.

The essential point in the electrical study of this line is a consideration of the best means for cheaply preventing electrical leakage from any wire to the earth or to neighboring wires, and in consequence, this subject has been one to which much ingenuity has been devoted since the earliest days of the construction of overhead lines.

In the first lines erected by Morse, the insulating properties of the wooden poles were thought to be sufficient, but it was soon found that while satisfactory transmission without excessive leakage would take place during dry weather, something more than even a layer of good wire insulation was necessary when the poles and cross-arms became saturated with moisture. At first the want of additional insulation was filled by the use of small blocks of porcelain or earthenware, which could be screwed to the poles, and which supported the wires, laid in grooves or strung through holes provided for this purpose.

In the early days of telegraph working, many miles of wire were supported in this manner both in American and European construction, but it did not take long for telegraph engineers to find that this form of insulator possessed several important defects. As long as the insulators were clean and fresh from the factory they gave perfect satisfaction in dry weather and reasonably good results when it was wet; but as soon as a layer of dust had accumulated over the surface, the slightest amount of moisture would convert this dust into a conducting film, and reduce the insulating properties very seriously. Furthermore, when the wires were strung through holes in the insulators, the difficulty of originally placing the insulators was very great, while a broken insulator could only be replaced by cutting the wire and interrupting the service, while when the wires were simply laid in grooves, they were easily thrown off during storms. Besides, these insulators gave no support when any one pole was overstrained or weakened in any way, since they simply carried the wires, which were not tightly attached to them.

The first efforts toward improvement were of the nature of attempting an increase of surface by making the insulators long, in the shape of a double hollow cone. This materially increased the length of the leakage surface, and especially maintained a

reasonably dry interior, except during the hardest storms, but as no method of tying to the insulators had been provided in this form, they were soon abandoned in favor of a simple spool of porcelain held by a screw, with the wire twisted around the groove. This gave additional mechanical support to the line, and facilitated the replacement of broken insulators, but retained the defect of a ready path for leakage over the surface. In consequence, the porcelain spool was soon relegated to indoor services, where it still exists in the form of the porcelain knob, which, as we know, is a satisfactory insulator for indoor construction, where it will remain dry and clean. Before this insulator was abandoned, attempts were made to protect it from moisture by covering each insulator with a wooden or metallic hood of such a shape as to readily shed rain away from the point of connection between the line and the pole, and while this was effectual to prevent a drenching of the insulator during rainstorms, it did not prevent an accumulation of moisture from fog or mist on the dirty surface of the insulator, while it was especially defective, as it prevented a complete washing of the insulator by the drenching rain, which from the very first was found to be one means of improving the insulation resistance of a dirty insulator. At the same time, the complete abandonment of the hood was not attempted until it was found possible to make the hood a part of the insulator itself. In consequence, the next step in improvement consisted of making a porcelain or earthenware hood with two lugs, by which it could be fastened to the pole, while the wire was supported by means of a metallic pin cemented in the interior of the hood. The insulator resembled closely an inverted coffee cup, with the wire supported by a pin cemented on the inside of the cup. This form still exists in the insulators used for supporting trolley wires in all metallic-sheathed insulators and in the so-called "paraffin" insulators, which are often employed where wires are entering telegraph offices. The porcelain lug, by means of which the insulator was fastened to the poles, was found to be defective mechanically, and although this was replaced by a groove and the insulator tied to the pole with a wire, the construction of lines carrying many wires was soon found to require some form of insulator which might be attached to a cross-arm. By reversing the positions of the insular support and the support of the wire, this result was accomplished. The wire was fastened in the groove around the outside of the insulator, while the insulator itself was supported by means of a pin set in the cross-arm, the pin itself being cemented or screwed into the interior of the insulator. This form is the common form of insulator employed at the present time, improvements which have been made consisting mainly in an extension of the surface, along which leakage can take place

by a multiplication of watersheds, or, as they are commonly called, "petticoats." One of the latest forms of these petticoat insulators is shown in our illustration (Fig. 1). It is designed for currents having a potential of 5,000 volts or less. It is 4½ inches in diameter, and 3½ inches high, and presents 8½ inches of surface between the wire and the pin. Like the porcelain insulator, this insulator has most of its surface on the bottom side.

In Fig. 2 another triple petticoat glass insulator is shown, made for potentials up to 20,000 volts.

Since the establishment of this design various materials have been employed in construction, and individual designers have changed the depth or location of the groove, and have varied

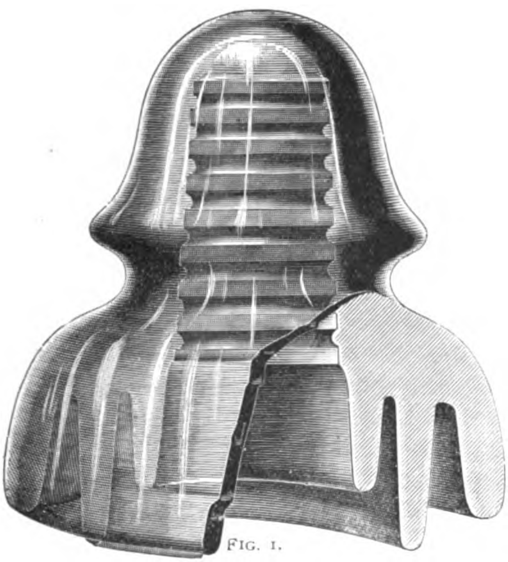


FIG. 1.

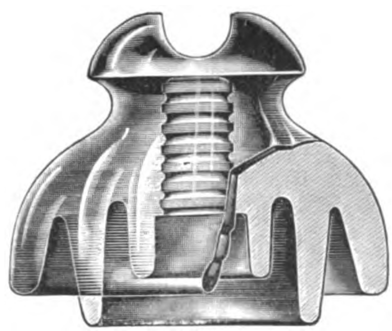


FIG. 2.

other mechanical details, but it is now considered that all good designs for line insulators to be supported by pins on cross-arms adhere to the following conditions:

The material used must have high specific insulation resistance, and present a surface not readily destroyed and on which no great amount of moisture is condensed from dampness in the atmosphere, while the mechanical strength, both under the influence of strains and vibratory shocks, must be as great as possible. In designing a particular form of insulator, the groove for the wire should be of sufficient depth that it will hold the wire securely in place when the wire is tied, by means of a loop or tie wire. The location of this groove should be such as to transmit the strain through the insulator to the pin, without inducing shearing strains in the body of the insulator. The form above

the groove and of the outer petticoat should be such that during a heavy rain the space under the petticoat will be kept as dry as possible, while the external surface of the insulator is being thoroughly washed. The space under the petticoat should not be so narrow that a ready circulation of the air be hindered, and the insulator caused to dry slowly after being dampened by mist. Finally, as little shelter as possible should be provided for insects that seek dark places in which to lay their eggs and form their cocoons. These conditions are largely of a mechanical nature, and it is obvious that the manner of their fulfillment depends largely upon the character of the material used, since each insulating material presents certain mechanical advantages and difficulties.

The principal materials that have been used in the construction of line insulators are glass, porcelain, pottery, hard rubber, "compressed mica," and lava. Of these, rubber is only suitable when it is possible to protect it from atmospheric influences, since all forms of rubber and ebonite are found to decompose on the surface and produce an external conducting film of sulphuric acid, when subjected to the influence of the sunlight, and consequently this material can only be properly employed in those insulators which have an external sheeting of iron or other metal, although when so employed, rubber has the advantage of withstanding easily severe vibratory strains that might be fatal to the more brittle glass or porcelain. Furthermore, it is easier to make the connection secure between the rubber and the iron sheeting than is possible with any of the harder insulating materials.

Lava of certain especial qualities, carefully selected and tested, seems to produce good insulators, which are exceedingly tough and strong, but its use has not been very extended on account of the fact that the lava insulator has to be machine turned from a large block of the material, and although lava works with comparative ease, the expense of this machine work is so great that its advantages are not generally considered to be commensurate with the increased cost of turned insulators.

The term "compressed mica" is a trade name for a composition of ground mica and shellac, molded under the influence of heat and pressure, the outside surface of shellac being smoothly glazed. This material has been very effectively used where great shocks are to be sustained, as for the insulators supporting trolley wires, but as the smooth shellaced surface of this material has no great weathering properties, it is not thoroughly suitable for line construction unless covered by a metallic sheeting, and even in such service its insulating properties, after repeated wettings by the rain and mists, are not sufficient for it to be considered as a

satisfactory material for insulator construction, except in resisting low potentials on lines subjected to great vibratory strains, where the slight leakage over the surface of the insulator is more than counterbalanced by its mechanical strength.

The material called "pottery," which is made from common clay, or hydrated silicate of alumina, from which the water of crystallization has been driven away by baking, is quite porous and only considered to be a good insulator when kept dry by means of a heavy external glaze. On this account the material is not in favor in this country, although many telegraph lines abroad are supported on pottery insulators, where it is favored on account of its great cheapness, as well as on account of the readiness with which colored glaze may be applied, different colors being preferred by different telegraph superintendents. But although, as has been said, the insulating properties are good when the glaze is intact, our engineers consider that the glaze is too readily ground off by the swaying of the wire or cracked away by carelessness in construction, for this material to be valued in the construction of insulators.

In place of pottery, glass is here commonly used, being preferred on account of its cheapness, its strength, its smooth surface and its transparency. The particular glass usually employed is a cheap form of soda glass made of reasonably pure sand, but without attempt to remove the last traces of metallic impurities. In consequence of the presence of a small amount of iron oxide, these insulators have a green color, although not of such a depth as to render them opaque. This glass, while more deeply colored than lead glass, is much cheaper and at the same time stronger, while its surface is less hygroscopic and more enduring, both under the influence of the solvent action of moisture and the grinding action of the line wires. In this country it is considered that the transparency of glass presents a decided advantage, as in consequence of this property there are no dark recesses within the insulator, and there are, therefore, no places especially attractive to insects, whose nests and cocoons cause serious inconvenience and loss of insulation where opaque insulators are employed. In some sections of the country this property is so important that efforts are made to obtain a glass nearly white, while all over the United States the presence of vast numbers of insects is of sufficient importance to render this property of glass valuable. The principal objections to the use of glass are that the material itself is quite brittle and the surface condenses and retains moisture more readily than that of other insulators.

By properly proportioning the size of the insulator to the strains likely to be endured along the line, the influence of the fragility is reduced to a minimum, although this is always a dis-

advantage where the lines are likely to be interfered with by falling wires, trees, or by malicious breaking of the insulators by stones or shot. On long lines the presence of malicious influence is not of great importance, and indeed this principle need only be considered where wires are run through the suburbs of a large city, although it would be desirable to obtain for good insulation a material less hygroscopic. It is common to consider that the hygroscopic character of the surface is of less importance in this country than the presence of insects, and until this problem shall be solved in some other manner, glass is likely to continue to be the standard material for the construction of small insulators, which cannot be made of an opaque material without dark recesses.

For heavy mechanical strains and high potentials, some of the principal objections to the use of glass are obviated in insulators

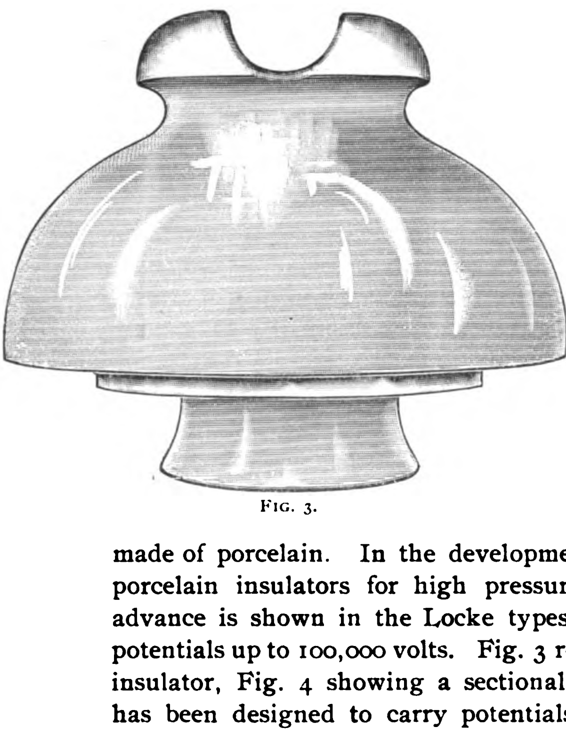


FIG. 3.

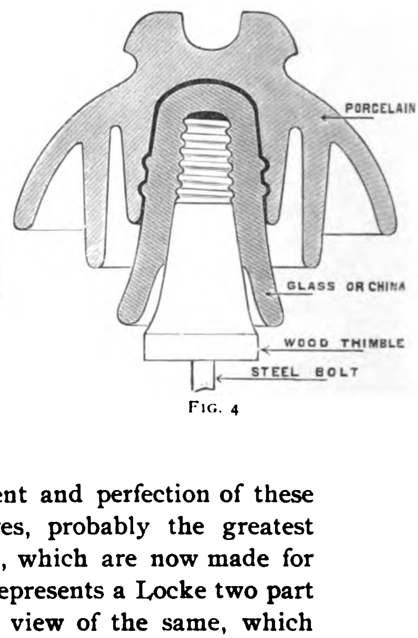


FIG. 4

made of porcelain. In the development and perfection of these porcelain insulators for high pressures, probably the greatest advance is shown in the Locke types, which are now made for potentials up to 100,000 volts. Fig. 3 represents a Locke two part insulator, Fig. 4 showing a sectional view of the same, which has been designed to carry potentials up to 50,000 volts, and which is made in several sizes according to the different currents to be carried. It is made with an outer shell of china ware on account of its high insulating surface, mechanical, as well as electrical strength, and has a center insulator of glass to further insulate it and to prevent puncture by the high potential current. It is also made of two or more shells of china ware, the advantage of this over one solid insulator is that the shells being made separately one-half inch thick, each allows a greater uni-

formity in making and more thorough vitrifaction, than could be obtained otherwise in one solid insulator one inch thick. Besides this Mr. Locke secures four thicknesses of glazing from the two shells, which further increases its insulating qualities. One thickness of shell being capable of standing, say one volt, the two together will stand double that amount. By repeated practical tests it has been found that a potential of 100,000 volts will not puncture the insulator; hence it will carry with safety and economy any voltage that is practicable for use in commercial application of electric power. Porcelain is a material which consists essentially of a hard body, made by the dehydration of hydrated silicate of alumina, in which the pores are filled by a suitable glass, producing a solid nonporous substance of considerable strength and toughness. This material differs from pottery in being more dense, whiter and less fusible, but particularly in being translucent. Indeed, many consider that the quality of translucency is the only one by means of which porcelain may be distinguished from pottery. Pottery, as we have said, is a ceramic ware, molded from paste of impure hydrated silica, containing certain amounts of free silica, lime and iron, together with a frequent admixture of organic matter. After this is baked to drive off the water of hydration, the product is opaque and invariably porous, on account of the removal of the volatile ingredients contained in the wet clay from which the ware is molded. Porcelain, on the other hand, consists partly of an almost pure silicate of alumina, but slightly hydrated, inclosed within a matrix of a hard silicate glass, the glass serving to fill up the porosities in the dehydrated silicate of alumina, and to make the material thoroughly nonabsorbent. Porcelain as used in the arts, however, is not a constant material, but varies from the variety called "hard-paste" (originally invented in China) to an altogether different material discovered by the French, and called "soft-paste" porcelain. The true, or hard-paste Chinese porcelain, is composed of a mixture of kaolin with a natural silicious glass found in China and called Petunese, while the soft-paste consists simply of a mixture of the kaolinic clay with an artificial glass composed of niter, soda, gypsum and salt, the proportion of kaolin to the glass being much less than in the natural Chinese product, and in consequence the resultant product partakes more of the character of glass in brittleness, although it is as free from porosity as is the true porcelain. Between these two are found the mixed or "bastard" porcelains, which are uncertain in character, but are all composed of kaolin, inclosed within a more or less fusible glass, and consequently varying in properties.

Porcelain insulators are rarely "thrown" on the potter's wheel from masses of clay, as was the ancient custom in ceramic

manufacture, but are made by pressing the clay into a matrix by means of a die. For this purpose the clay, which has been thoroughly ground and mixed in water, is dried to the condition of a damp powder, which is then filled into the matrix and pressed into the form of the finished article by means of a die. In this method of working, a minimum amount of water may be used, and in consequence the proportion of fusible material may be decreased with the result that the finished article is made more dense and tough, but at the same time it is impossible for the moisture to be entirely eliminated from the clay until it is subjected to the heat of a potter's kiln. That this process removes a very considerable amount of water from the mass, is shown from the fact that the shrinkage in baking amounts to as much as the shrinkage in the cooling of cast iron, namely, a shrinkage of one-eighth in the linear dimensions. The spaces left by this water are filled by the fusion of the glass with which the kaolin is mixed. When this mass of clay is baked to drive off the water of hydration, and the biscuit thus produced is dipped into a thin paste of glaze and again fired until all the fusible material is thoroughly vitrified, the resultant insulator presents a smooth-glazed surface and a body without porosity. When so manufactured, there is no doubt that an insulator is made which is tougher and stronger than any that may be made from glass entirely. Besides, the surface of the glaze, although this is indeed a glass, is found to condense water from the atmosphere much less readily than the surface of solid glass. The proper porcelain for insulation, therefore, is that in which there is only such an amount of glass present as is necessary to fill up the porosity of the dehydrated silicate of alumina, since when this proportion is attained, the greatest strength consistent with non-porosity is reached. Should the amount of glass be increased beyond this point, or should a more readily fusible glass be used, the porcelain will become brittle, although it will still remain nonporous, but nonporous just as glass is nonporous, and, hence, without the advantage over common glass supposed to be possessed by a hard-paste porcelain. If the amount of glass present is only so much as will fill up the pores left by the escaping water as the silicate of alumina is dehydrated, we can readily see that such porcelain has no property by means of which wide cracks in the molded clay can be filled, since at no temperature available within the pottery kiln will the mass fuse and run. We may indeed say that the glass is drawn into itself by the porous silicate of alumina by capillary attraction, and when spaces are present which are not capillary, these spaces cannot be filled. The solidity of the finished article in hard-paste porcelain manufacture depends, therefore, upon the solidity of the molded clay.

Hard-paste porcelain is made of materials expensive in themselves, difficult to mold and fusible only at a very great heat, therefore, the temptation to increase the amount of glass in the material and to use glass fusible at a comparatively low temperature is very great, although the material resultant from such change is found to possess the valuable properties of porcelain in a very seriously diminished degree. In consequence, many of the bad results found in insulators are due to a fragility and excessively hygroscopic character caused by a degradation of the material. This degradation is exceedingly difficult to detect, since the highest experts on porcelain wares are often at a loss to determine whether the body of a finished article is hard or soft paste porcelain, without determining its crushing strength, and, of course, a mechanical test is very hard to apply to such an irregular body as a line insulator. Even where the best materials are invariably used, certain forms of insulators cannot be molded in the matrix and die, for the reason that the clay when pressed is not a liquid body, and in consequence pressure applied all in one direction is likely to produce cleavage lines in the insulator, which are especially apt to occur where irregularities of pressure are sustained, due to a variation in the thickness of the parts of the insulator. This difference in thickness of the various parts of the insulator is also a source of danger during baking, an effect of the great shrinkage already mentioned.

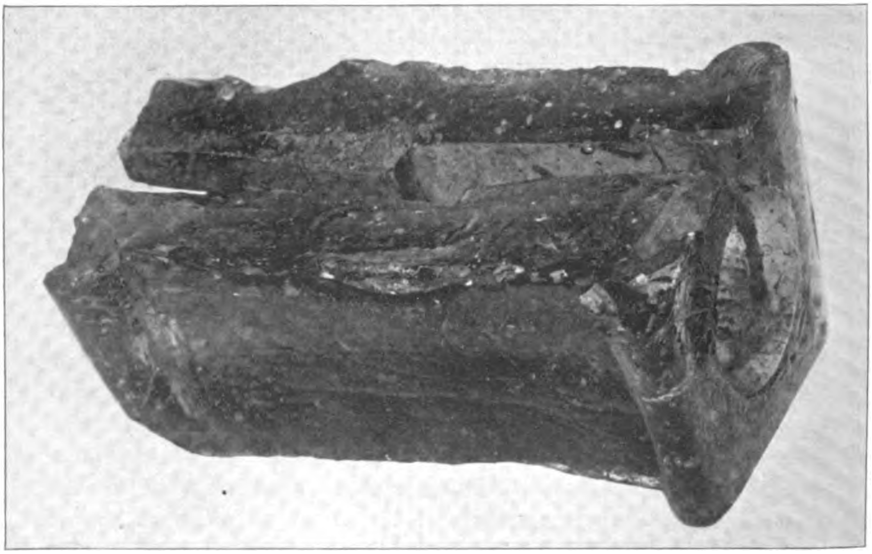
Another difficulty in the manufacture of porcelain insulators is found in the choice of a proper glaze. The glaze must not only present a smooth surface, but also be of nearly the same coefficiency of expansion as the body of the insulator, in order that minute cracks may not occur when the finished articles are taken from the kiln and exposed to the action of the atmosphere. It is true that the glaze does not prevent leakage through the body of the insulator itself, but we depend upon it for preventing the retention of moisture upon the surface, and the nonhygroscopic character of porcelain depends, therefore, upon the character of the glazed surface, and also upon its mechanical perfection. To obtain a glaze which will not be roughened by the action of weathering and will not be worn away by abrasion from the line wire is, indeed, an impossibility; at the same time, care should be taken that these defects are not accentuated by minute cracks within the glaze itself. The proper porcelain insulator is, therefore, one which is made of hard-paste porcelain of great mechanical strength, formed so that internal cracks are not produced during manufacture, and which has been finally glazed with a thin coating of a smooth, hard glass.

The difficulties encountered in the manufacture of a porcelain insulator, due to the varying thicknesses of the parts, are over-

come in certain forms by manufacturing the insulator in more than one part, the different parts being fastened together by means of cement or by means of a thick coating of glaze. This method of manufacture was attempted in the earliest history of the use of insulators, and while this may overcome certain difficulties in the manufacture, there seems to be no essential difference between the resultant multi-part insulator and that which has been properly made from one piece. In either case, the insulators are found to withstand high voltages and to properly sustain the line whenever the leakage surface and the thickness of the insulator is made sufficient.

AN HISTORIC INSULATOR.

Those who are familiar with the form of insulators used today in trees and places where the permanent fastening of the wire is not desirable, will be interested to learn that as far back as 1848 this particular form was used, both in glass and porcelain. Through the courtesy of Mr. J. J. Nate, superintendent of the Standard Electric Company, Madison, Wisconsin, we are enabled to give a photographic reproduction of what is probably the



oldest specimen of that type of insulator in existence. The form is the one used originally on the Washington-Baltimore line, while the particular insulator shown was in use for years on one of the first lines built in Wisconsin. The line ran from Mineral Point to Lancaster by way of Potosi. It was constructed in 1848, probably by a man named Lundy, who seems to have had an interest in its installation.

THE ALGEBRA OF ELECTRICITY.

II.—BY CHAUNCEY G. HELLICK.

If a long thin bar of iron be magnetized, it will be found upon examination that the property imparted to it of attracting iron and other magnetic substances is confined to the ends, or rather, to regions near the ends called *poles*. These poles are somewhat indefinite in position, but are close to the ends of the magnet, being distant from each other in a straight bar about .80 or .85 of its length. The line joining the centers of magnetic action is called the *magnetic axis* of the magnet, the distance between them, the *magnetic length.*

If two magnetic poles be brought near one another, there will be an action between them, either of repulsion or attraction, according as they are similar or dissimilar, whence the rule, "Like poles repel, unlike poles attract," one end of every magnet being called a north pole, and the other end a south pole. The magnitude of the action between a pair of poles is a measure of the *strength* of those poles. We are thus furnished with a means of defining *unit* strength of pole; if two poles be separated a distance of one centimeter, and the force between them be *one dyne*, they are *unit* poles. The distance remaining the same, if one of the poles be of strength m, the force of attraction or repulsion is m dynes, if one be of strength m, the other of strength m', the distance between them being still one centimeter, the force is $m\,m'$ dynes. The law of the action is that the force of attraction or repulsion between two magnetic poles varies directly as the product of the pole strength, and inversely as the square of the distance separating them; or algebraically,

$$\text{force} \sim \frac{m\,m'}{d^2}$$

where $m\,m'$ are the strengths of the poles separated a distance d.

We can convert this expression into an equation by multiplying the right-hand member by a constant; thus,

$$\text{force} = k\,\frac{m\,m'}{d^2}$$

This constant is independent of the quantities m, m' and d, and depends upon the units in which they are measured, and the medium in which the action occurs.

If we assume *air*, or rather *vacuum* as the standard medium, and properly select our units, the constant k becomes unity, and we may write simply,

$$\text{force} = \frac{m\,m'}{d^2}$$

If the poles be of equal strength,

$$\text{force} = \frac{m}{d^2}$$

From this equation we can find the dimensions of pole strength, for

$$\text{force} \times \overline{\text{dist.}}^2 = m,^2$$

whence,

$$m = \sqrt{\text{force}} \times \text{dist.}$$

The dimensions of force are $C\,G\,S^{-2}$, and of distance C, whence the dimensions of pole strength are

$$C^{\frac{3}{2}}\,G^{\frac{1}{2}}\,S^{-1}$$

A *field* of *force* is a region in which work is performed in moving in certain directions. Such a field exists about the earth, for between it and all bodies there is an attraction, and work is performed in moving bodies upward from the earth's surface. A field of force surrounds a magnet, a conductor conveying a current, a dynamo electric machine. Such fields are imagined marked out by *lines* of *force*, which show by their directions the paths which magnetic poles under their influence would follow, if free to move along them. The positive direction of the

field is the direction in which an isolated north pole — if such a pole were a physical possibility — would move, the magnetic direction being that taken by a south pole.

If a magnetic pole be placed in a magnetic field, it moves with a force proportional conjointly to the strength of the pole and the strength of the field, a field of *unit* strength being one which acts on a unit pole with a force of one dyne. Generally

$$\text{force} = H \times m$$

where H represents the strength of field, and m, as before, the strength of pole.

The equation

$$H = \frac{\text{force}}{\text{pole strength}}$$

gives as the dimensions of field strength

$$C^{-\frac{1}{2}}\, G^{\frac{1}{2}}\, S^{-1}$$

A uniform field is one in which the direction of the force is everywhere the same, and the strength equal in all parts of the field — that is, the lines of force are parallel and equidistant (the extent to which they are crowded together furnishing a means of estimating the field's strength).

A long bar magnet placed with its magnetic axis at right angles to the lines of force of such a uniform field, will experience an action tending to turn it parallel to the lines. If H be the strength of the field, and m that of the poles of the magnet, the north pole will tend in the positive direction with a force of Hm dynes. The south pole will be urged in the opposite direction with an equal force. These forces being equal and opposite form a couple whose moment is HmL, where L is the magnetic length of the magnet. If the field be of unit strength, this moment has the value mL, whence the definition of the moment of a magnet — the strength of either of the poles multiplied by the distance between them.

The dimensions of magnetic moment are

$$C^{\frac{5}{2}}\, G^{\frac{1}{2}}\, S^{-1}$$

If we consider a magnet pole we may imagine it magnetic because of some property imparted to it, perhaps by rubbing it with another magnet. In this sense we may regard the magnetism as distributed over the polar surface with an intensity measured by the magnitude of its action on a unit distribution. The *intensity* of *magnetization* thus given is the ratio of the magnetic strength to the polar area. If we multiply this area by the length of the magnet we have the volume of the magnet. If the pole strength be multiplied by the length, we have the magnetic moment. Hence, the intensity of magnetization equals the polar strength divided by the polar area, or the moment of the magnet divided by its volume; in other words, the intensity of magnetization is the pole strength per unit of area, or the magnetic moment per unit of volume. The dimensions of intensity of magnetization are thus:

$$\frac{C^{\frac{3}{2}}\, G^{\frac{1}{2}}\, S^{-1}}{C^{2}} = C^{-\frac{1}{2}}\, G^{\frac{1}{2}}\, S^{-1}$$

It will be observed that these dimensions are the same as those of field strength, which correspondence suggests another method of considering the peculiar quality (magnetism) imparted to the magnet. We may look to the region surrounding the magnet, regarding it as being permeated by lines of force given off by the poles. The conception of lines of force is, of course, purely artificial, introduced for the purpose of easily and satisfactorily explaining the different phenomena observed. To this end we adopt a convention as to the number of lines of force in a unit field, so as numerically to express in lines the strength of any other

field. We say that a unit field is one in which there is one line of force per cm^2 of area at right angles to the field. A field of strength numerically equal to five would then be one in which there are five lines per cm^2; of strength .5 one in which there is one line to every two cm. In accordance with the rule we can easily find the number of lines of force emanating from a unit pole. As unit field surrounds such a pole at unit's distance from it, we have simply to find the number of cm^2 in the surface of a sphere of one cm radius; for since there is in a unit field one line of force per cm^2, there are as many lines of force as there are cm^2. The area of the surface of a sphere of radius r is $4\pi r^2$, hence of a sphere of unit radius the area is 4π. ($\pi = 3.1416$, which is the ratio of the circumference of a circle to its diameter.) There are, therefore, 4π lines proceeding from a unit pole. If the pole be of strength m the number is m times as great, that is $4\pi m$.

The multiplier 4π, here encountered for the first time, is continually recurring in magnetic formulæ, to obscure their meaning, and to make their physical interpretation of exceeding difficulty to the beginner. The definition, as given above, of unit magnetic pole, is responsible for this undesirable sequel. An effort has been made by Mr. Oliver Heaviside so to modify it that the coefficient 4π disappears from some of the more important formulæ. The *rational* system so built up defines a unit magnetic pole as one which acts on an equal pole with a force of $\frac{1}{4\pi}$ of a dyne. Followed through, this definition leads to the conclusion that a unit pole has emanating from it one line of force, or as it is better expressed, one unit of magnetic flux. It certainly seems more rational so to consider a unit pole, than to regard it as giving off 4π such units. Of course, removing the objectionable factor from some expressions only causes it to appear in others, but, on the whole, a general acceptance of the rational system would result in considerable simplification.

A CONVENIENT INSPECTORS' SET.

Every inspector or trouble man has often felt the want of a particular tool, be it a screw-driver, pliers or file, when coming across trouble that had to be remedied at once. Loading the pockets with a collection of these different tools is at best unsatisfactory, and usually results in the perforation of the pockets and consequent loss of the tool. In a neat little morocco case, easily slipped into the side pocket, is arranged a complete collection of small tools required by the inspector.

INSPECTOR'S SET.

The list comprises a large and small screw-driver, a pair side-cutting Stubbs pliers, a pair of tweezers, an oil can, flat file, punch, oil stone, and a small case for holding screws, fuses, etc., making altogether one of the handiest collections that can be added to the inspector's kit. The outfit is placed on the market by the American Electric Telephone Company, Chicago.

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CHICAGO, NOVEMBER, 1898.

PROBABLY never in the history of the independent telephone movement has there been such evidence of prosperity and sound progress as at the present time. Every prominent manufacturer has orders on the books for exchange equipments ranging in capacity from a modest 50-drop board to the more elaborate switching systems of 2,000 or 3,000 lines capacity, rivaling in perfection of design, construction and operation anything ever produced by the Bell Company.

A striking illustration of what can be accomplished by united action and a firm determination not to be bulldozed by any of the bullying methods of the Bell Company is shown in the history of the independent exchange at Lafayette, Indiana, given elsewhere in this issue. Starting just six years ago with a handsome list of over four hundred subscribers, nearly double of what the Bell Company, at the time, with its miserable service and extortionate rates, had been able to obtain, subscriber after subscriber was added, until just recently even the new 1,000-line switchboard became too small to satisfy the increasing demand for service on the part of the fair-minded citizens, who are willing to pay a reasonable price for what the Bell Company is offering for nothing. The success of this exchange is but the experience of hundreds of others, and clearly indicates the wisdom of investors in entering the independent field.

INDEPENDENT TELEPHONES IN SOUTHEASTERN KANSAS.

Four years ago not an independent telephone exchange could be counted in the southeastern part of Kansas, while today some sixteen independent companies and firms are doing a successful and profitable business. Among them may be mentioned: the Heckman Telephone Company, Independence; the Wareham & Wood Telephone Company, Chanute; George R. Crawford, Girard; the Mutual Telephone Company, Fort Scott; the Union Telephone Company, Fort Scott (long-distance only); the Iola Telephone Company; the Kansas Telephone and Electrical Company, Parsons; the Chetopa Telephone Company; the Galena Telephone Company; the Coffeyville Telephone Company; C. S. Penwell, Eureka; the Neodesha Telephone Company; the Garnett Telephone Company; the Osawatomie Telephone Company; the Weir City Telephone Company, Weir City; the Ottawa Telephone Company, Ottawa.

Quite a number of these have constructed long-distance lines connecting them with other towns.

Not a single Bell exchange has been built in the territory mentioned, and no Bell exchange has been increased during that time, except at Pittsburg, where threatened competition produced a reduction of Bell rates and enlarged the patronage.

Wherever in the above towns the independent company has Bell competition, the latter invariably "bushwhacks" by charging either nominal rates or giving free 'phones, while the independent

companies have uniformly preserved their original rates and have prospered.

Under such conditions the independent people naturally feel happy and elated, enjoying the benefits of good service at reasonable rates.

CHARLES H. SUMMERS.

Charles H. Summers, chief electrician of the Western division of the Western Union Telegraph Company, died at San Francisco on the 2d inst. Through his unexpected demise the electrical world loses one of its brightest and most progressive contributors to the electrical development of his time, who took an active and successful part in the improvements of the art of telegraphy, as well as in the introduction of the electric light and the telephone and in the study of inductive effects, while his family mourns the loss of a most indulgent husband and the kindest of fathers.

For some thirty years Mr. Summers had his home and office in Chicago, and while for the past ten years he had not been so active in electrical study and research, his contemporaries of the earlier days knew of and realized the value of his work. He had a wide acquaintance among the foremost men of the country, particularly in the electrical industries, and his amiable and cheerful disposition made him ever a desirable acquaintance and welcome guest.

Mr. Summers left Chicago on October 24, on a leisurely business trip, in good spirits and apparently fair health. On the evening of November 2, in San Francisco, he dined with Mr. D. R. Davis, of the Western Union Telegraph Company. After dinner he and Mr. Davis went to the Palace Hotel, where they engaged in conversation for some time. A little later Mr. Summers proposed a walk. While they were walking, at about 10:45 P.M., Mr. Summers complained of sudden illness. Mr. Davis supported him to a lodging house in the vicinity and summoned a physician, but before the physician arrived Mr. Summers expired, very peacefully and without pain. The physician stated that death was due to inflammation of the heart.

Charles H. Summers was born in Fleming County, Kentucky, on July 6, 1837. His ancestors were Virginians, dating back to 1609. He was but a boy when he entered the telegraph service in 1854, as an operator on the old Pittsburg, Cincinnati & Louisville line, built over the highway from Pittsburg to Louisville, of which James D. Reid was superintendent. After this line was consolidated with the Western Union Telegraph Company, he worked at different points as an operator, and, in 1859, while working at Indianapolis, was offered and accepted a good position on the railroad lines. Indianapolis was his headquarters until 1867, when he was made superintendent of telegraph of the Indianapolis, Cincinnati & Lafayette Railroad telegraph lines and located at Cincinnati. In 1869 he was called to Chicago as chief electrician of the Western division of the Western Union Telegraph Company by Gen. Anson Stager, and remained in the service of the company from that time until his death.

Mr. Summers was twice married. His first wife was Miss Emma Porter, to whom he was united in 1859 at Ripley, Ohio. Mrs. Summers died in 1873, and several years later Mr. Summers was married to Miss Anna Porter, who survives him. There are seven children — Misses Florence, Maud and Neva Summers, of Chicago; Mrs. A. W. Towsley, of Roanoke, Virginia, and Leland L., Bertrand S., and Ray P. Summers, of this city. Mr. Leland L. Summers was formerly with his father as assistant electrician of the Western Union Company. Later he was connected with the Postal Telegraph Company as electrician of the Western division. Since 1894 he has maintained an office in Chicago as a consulting engineer. Mr. B. S. Summers is the chief chemist of the Western Electric Company, while the youngest son is still at school.

The funeral services were held on Tuesday afternoon at Mr. Summers' late residence, 661 Fullerton avenue. Rev. Jenkin Lloyd Jones delivered a touching address, during which he read two of Mr. Summers' poems very effectively. The tribute of flowers was beautiful and extensive.

Among the large number of electrical men in attendance were the following

named officers of the Western Union Telegraph Company: R. C. Clowry, vice-president, Chicago; F. H. Tubbs, district superintendent, Chicago; J. J. Dickey, district superintendent, Omaha; T. P. Cook, district superintendent, St. Louis; I. McMichael, district superintendent, Minneapolis; W. J. Lloyd, assistant district superintendent, Chicago; F. R. Steele, manager, San Francisco; E. M. Mulford, manager, Chicago; C. H. Bristol, superintendent of construction, Chicago; V. T. Kissinger, H. E. Roberts, J. F. Morgan, F. J. Scherrer, L. J. Amsden, Chicago.

SOME NEW BELL TYPE SWITCHBOARD ACCESSORIES.

The American Electric Telephone Company, Chicago, always ready to apply the latest improvements in the design and manufacture of its various devices, has recently perfected some of the smaller exchange accessories, upon the correct and accurate operation of which depends to a large extent the efficiency of an entire exchange. In the improved double pole head receiver (Fig. 1) several new features have been applied. The pivoted earpiece makes it readily adjustable to any shape of the head,

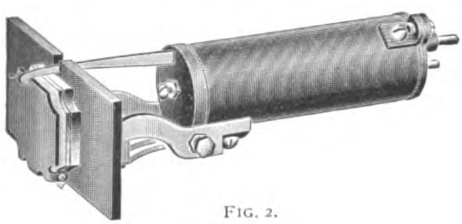


FIG. 2.

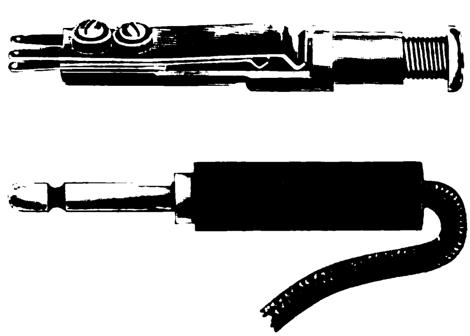
while the morocco-covered headband does away with the disagreeable feeling of the bare metal. All of the case, excepting, of course, the magnet and coils, is made of aluminum, making the shell of extreme lightness, and all in all giving the most efficient operator's 'phone on the market.

Another valuable improvement is shown in Fig. 2, in a new form of tubular, Bell style, drop. In this drop the coil can be easily and quickly removed without interfering with the adjustment of the armature, while the air gap is so small and the adjustment so accurate that the shutter will fall easily with ordinary series magnetos. Hence, it is not necessary to change the bells or ringer coils

FIG. 1.

to properly balance the resistance of line. The drop has been tested and found to fall readily through 11,000 ohms, while nearly all other makes were found to ring only fairly well through 5,000 ohms.

The improved jack and plug (Figs. 3



FIGS. 3 AND 4.

and 4) is another improvement over the older forms of this important part of a board. The method of connecting the

cord ends to the tip and shell will be especially appreciated by all managers who have been troubled with loose and imperfect connections in the plugs. The tip unscrews from the shell and has a small spring-actuated plunger arranged within, to which one end of the cord is carried, the other end being in contact with the outer shell. This does away with any soldered connections, the stiff spring always securing good contact with the tip, while the screwing up of the shell securely fastens the other end of the cord. In the jack the adjustable clamping end is quite a valuable feature, allowing for any variation in the thickness of the board. Few parts, simplicity of construction and non-liability to disarrangement combine in making this one of the best devices of the kind.

STRAINS ON TELEPHONE WIRES.

The strains to which telephone wires are subjected when they are weighted with snow or ice may be realized from the fact that in Switzerland even after an ordinary snowfall or during frost the snow or ice deposit on a No. 12 telephone wire often reaches a thickness of over an inch, or fifteen times that of the wire. In a recent fall of snow at Zurich it was observed that the snow deposit on telephone wires had a diameter of no less than two and a quarter inches, or thirty times that of the wire. Taking the specific gravity of the moist snow deposit at one-fifth of the volume, a span of 300 feet would thus have a snow weight of 120 pounds, or more than twenty times the weight of the wire. Many of the telephone posts at Zurich support iron frames, carrying as many as 250 wires. The snow weight on these, therefore, in a span of 300 feet would be fifteen tons, or twenty times more than the weight in copper.

RILEY, WIS., will soon have telephone connection with the outer world.

NEBRASKA CITY, NEB.— A new telephone exchange will soon be in operation in this city. Mr. H. A. Coit has secured a franchise, and work has been commenced. The rates will be $24 for business and $12 for residence 'phones.

ANCIENT METHODS OF TELEGRAPHY.

BY LAWRENCE IRWELL.

It is not improbable that many persons are unacquainted with the fact that telegraphy of a primitive kind existed centuries before the invention of the electrical apparatus which we now use, and that many expedients were resorted to in bygone days for communicating with persons at a distance. The word "telegraph" is taken from the Greek τῆλε (tele) afar and γράφειν (graphein) write, and has consequently no necessary connection with electricity. Perhaps it may be well to mention that carrier-pigeons, speaking tubes and the like are outside the category of signal-making machines, adapted to express at a distance letters or words which at close quarters might be either spoken or written, as are also the various means employed to communicate a certain piece of intelligence, such as the result of any particular event, by signals previously agreed upon, as by lanterns, flags, fires, guns or drums.

The ancient Greeks and Romans practiced telegraphy by means of pots filled with straw and twigs saturated in oil, which, being placed in rows, expressed certain letters, according to the order in which they were lighted. The only one of their contrivances which merits a detailed description was that invented by a Grecian commander named Æneas, who lived in the time of Aristotle, intended for communication between the generals of an army. Two earthen vessels, identical in size and shape, were filled with water and each was provided with a valve that would discharge an equal quantity of water in a given time, so that the whole or any part of the contents would escape in precisely the same period from both vessels. Upon the

surface of each there floated a piece of cork supporting an upright, marked off into divisions, a certain sentence being inscribed upon each portion of the upright. One of the vessels was placed at each station; and when either party desired to communicate, he lighted a torch, which he held aloft until the other did the same, as a sign that he was all attention. On the sender of the message lowering or extinguishing his torch, each party immediately opened the valve of his vessel, and so left it until the sender relighted his torch, when it was at once closed. The receiver then read the sentence on the division of the upright that was level with the mouth of the vessel, and which, if everything had been executed with exactness, corresponded with that of the sender, and thus the desired information was conveyed.

One great advantage that this contrivance, simple as it undoubtedly was, possessed over the more scientific inventions which I shall attempt to describe, was its equal efficiency in any sort of country and in any position, whether on a plain, on the summit of a hill or in a sequestered valley.

Coming to more modern times — Keppler, in his "Concealed Arts," published about 1600, advised the cutting out of characters in the bottom of casks, which would appear luminous when a light was placed inside. In the "Proluciones Academicæ" of Strada, the Italian historian, published in 1617, the modern system of telegraphy is curiously indicated. The translation which is at my disposal says: "Strada gives an account of a chimerical correspondence between two friends by the help of a certain loadstone, which had such virtue in it that if it touched two several needles, when one of the needles so touched began to move, the other, though at ever so great a distance, moved at the same time and in the same manner. Two friends, being each of them possessed of one of these needles, made a kind of dial-plate, inscribing it with the four and twenty letters in the same manner as the hours of the day are marked upon the ordinary dial-plate. They then fixed one of the needles on each of these plates in such a manner that it could move round without impediment so as to touch any of the four and twenty letters. Upon the friends separating from one another into distant countries, they agreed to withdraw themselves punctually into their closets at a certain hour of the day, and to converse with one another by means of this invention. Accordingly, when they were some hundred miles asunder, each of them shut himself up in his closet at the time appointed, and immediately cast his eye upon his dial-plate. If he had a mind to write anything to his friend, he directed his needle to every letter that formed the words which he had occasion for, making a little pause at the end of every word or sentence, to avoid confusion. The friend, in the meanwhile, saw his own sympathetic needle moving of itself to every letter which that of his correspondent pointed at. By this means they talked together across a whole continent, and conveyed their thoughts to one another in an instant over cities or mountains, seas or deserts."

It was not until near the close of the seventeenth century that a really practical system of visual signaling from hill to hill was introduced by a Doctor Hooke, whose attention had been drawn to the subject at the siege of Vienna by the Turks in 1683. He erected on the top of several hills having a sky-line background three high poles, connected at the upper ends by a crosspiece. The space between two of these poles was

filled in with timbers to form a screen, behind which the various letters were hung in order on lines. By means of pulleys they could be run out into the clear space between the second and third poles, when they would stand out against the sky-line. The letters were run out and back again in the required order of spelling, and were divided into day and night letters — the former being made of pine, the latter having the addition of lights. There were also certain conventional characters to represent such sentences as, "I am ready to communicate," and "I am ready to receive." In the inventor's description of the device, read before the English Royal Society in 1684, Doctor Hooke, after claiming for it the power of transmitting messages to a station thirty or forty miles distant, said: "For the performance of this we must be beholden to a late invention, which we do not find any of the ancients knew; the eye must be assisted with telescopes, so that whatever characters are exposed at one station may be made plain and distinguishable at the other." A cipher code was subsequently added by a Frenchman named Amontons.

In 1767, Mr. Richard Edgeworth, the father of the authoress, Maria Edgeworth, employed the sails of a common windmill for communicating intelligence by an arranged system of signals, according to the different positions of the arms. The signals were made to denote numbers, the corresponding parties being each provided with a dictionary in which the words were numbered. This system was in vogue in almost all armies prior to about 1870, when what is known as the Morse alphabet was substituted for it.

By way of illustrating the undoubted advantage which the numerical system has over the letter system, let us imagine the case of an allied army in which different languages are spoken. With the aid of a vocabulary in which words of the same meaning in the different languages of the nations comprising the force had the same number attached to them, intercourse could be carried on from one language into another, which, though perhaps not strictly grammatical, would be intelligible.

A great stride was made in 1795 by Mr. Chappe, a resident of Paris, France, when the French Revolution directed all the energies of France to the improvement of the arts of war. In the report of Barère de Viewzac of this machine, the following words appear: "By this invention, remoteness and distance almost disappear, and all the communications of correspondence are effected with the rapidity of the twinkling of an eye." The contrivance consisted of a strong wooden mast some twenty-five feet high, with a cross-beam 12 feet by 9 inches, joined on to its top, which was movable about its center like a scale-beam, so that it could be placed horizontally, vertically or in almost any other position by means of ropes. To each end of this cross-beam was affixed a short vertical indicator about four feet long, which turned on pivots by means of cords, and to the end of each was attached a counterweight, almost invisible at a distance, for balancing purposes. The machine could be made to assume certain positions which were representative of or were symbolical of letters of the alphabet. In working, nothing depended upon the operator's manual skill, as all the movements were regulated mechanically. The time taken up for each movement was twenty seconds, of which the actual motion occupied four; during the other sixteen, the telegraph was kept stationary, to allow of its being distinctly observed and the communication written down by the proper official. All the

parts were painted dark brown, that they might stand out well against the sky. Three persons were required at each station, one to manipulate the machine, another to read the messages through a telescope, and the third to transfer them to paper, or repeat them to number one to send on. The first machine of this kind was erected on the roof of the Paris Louvre, to communicate with the army which was then stationed near Lille, between which places intermediate stations from nine to twelve miles apart were erected. The different limbs of the machine were furnished with lamps for night work.

Shortly after this, the British government set up lines of communication at various points on the coast. In 1796 the following statement was printed: "A telegraph has been erected over the Admiralty (the navy office in London), which is to be the point of communication with all the different seaports in the kingdom. The nearest telegraph to London has hitherto been in St. George's Fields; and to such perfection has this ingenious and useful contrivance been already brought, that one day last week information was conveyed from Dover to London (66 miles) in the space of only seven minutes. The plan proposed to be adopted in respect to telegraphs is yet only carried into effect between London and Dover; but it is intended to extend it all over the kingdom. The importance of this speedy communication must be evident to everyone; and it has this advantage, that the information conveyed is known only to the person who sends and to him who receives it. The intermediate posts have only to answer and convey the signals."

The machines used consisted of three masts connected by a top-piece. The spaces between the masts were divided into three horizontally, and in each partition a large wooden octagon was fixed, poised upon a horizontal axis across its center, so that it could be made to present either its surface or its edge to the observer. The octagons were turned by means of cranks upon the ends of the axles, from which cords descended into a cabin below. By the changes in the position of these six octagonal boards, thirty-six changes were easily exhibited, and the signal to represent any letter or number was made, thus: one board being turned into a horizontal position so as to expose its edge while the other five remained shut or in a vertical position, might stand for A; two of them only in a horizontal position for B, three for C, and so on. It was, however, found that the octagons were less evident to the eye at a distance than the indicators of Chappe's machine, requiring the stations to be closer together. Further, this telegraph could not be made to change its direction, so that it could only be seen from one particular point, which necessitated having a separate machine at the Admiralty for each route, as well as an additional one at every branch point. Moreover, the whole contrivance was bulky and of a form unsuitable for illumination at night.

About the year 1800, John Boaz, of Glasgow, Scotland, obtained a patent for a telegraph which effected the signal by means of twenty-five lamps arranged in five rows of five each, so as to form a square. Each lamp was provided with a blind, with which its light could be obscured, so that they could be made to exhibit letters and figures by leaving such lamps only visible as were necessary to form the character.

The next improvement came again from France, about the year 1805, when an entirely new set of telegraphs on the following principle was established along the whole extent of the coast of France:

A single upright pole was provided with three arms, each movable about an axis at one end — one near the head, the other two at points lower down, all painted black, with their counterpoises white, so as to be invisible a short distance away. Each arm could be made to assume six different positions — one straight out on either side of the pole, two at an angle of forty-five degrees above this line, and two at forty-five degrees below it. The arm near the head could be made to exhibit seven positions, the seventh being the vertical; but as this might be mistaken for part of the pole, it was not employed. The number of combinations or different signals that could be rendered by this machine, employing only three objects, was consequently 342 against 63 by that of the British naval office, which has been described above.

It was not long, however, before England copied the improvement of her neighbor across the channel, and in some respects changed the device for the better. The chief differences were that only two arms were used — one at the top, the other half-way down — and the mast was made to revolve on a vertical axis, so that the arms could be rendered visible from any desired quarter. The mechanism was such that the arms could be moved by means of screws worked by iron spindles from below, a great improvement on the old cords, especially when they were made to work inside the mast, which was hollow, hexagonal in section, and made of six boards bound together by iron hoops. Inside the cabin two dials were erected, one for each arm, an index finger that worked simultaneously with its corresponding arm above being a part of the apparatus, the principle being similar to that of the railroad semaphore.

This concludes the most prominent of the numerous contrivances which, prior to the application of electricity, were devised and utilized for telegraphic communication. All of them, unlike electricity, which, of course, can travel at night and can be employed in almost all weathers, possessed a common weakness in their liability to failure through atmospheric causes, such as fog and snowstorms. To us who live in this age of electrical marvels, when the use of electricity progresses "by leaps and bounds," it seems strange, almost incredible, that so many years were allowed to elapse before the parents of the electric telegraph — the electrical machine and the magnetic compass — were united to produce the contrivance by which two persons, however far distant from one another, can hold rapid and easy communication.

GRATIFYING SUCCESS OF THE VICTOR TELEPHONE MANUFACTURING COMPANY, CHICAGO.

During the last thirty days the Victor Telephone Company has sent out the following exchange equipments: A 200-line switchboard, with 'phones, to Mitchell, South Dakota; a 100-line capacity switchboard to California, Missouri; a 200-line outfit to Paxton, Illinois, and an equipment of 150-line capacity for Rantoul, Illinois, including all exchange apparatus and telephones. Purchasers give the highest indorsement of the superiority and many meritorious points of the Victor metallic board. This board is equally adapted to common return, grounded circuit and toll-line work without any change in wiring whatever. It has proven a revelation to the telephone world, and contains many points of merit long sought for by the independent field and not contained in the best Bell products. This company reports having work in hand in its factory at present for over 1,200-line capacity in switchboards, for early delivery to various exchanges. Their new catalogue will be sent to all exchanges upon request in writing.

THE INSPECTOR AND THE TROUBLE MAN.

BY THE INSPECTOR.

"This young man has been with us all summer, and as he seems willing and quick to learn, I would like to have you put him on trouble until we get things straightened out."

So read the body of a note brought to George Wilson, the new electrician of the Independence telephone exchange, that had been started some two years before, but which, owing to carelessness and incompetence of former workmen, to say nothing of the total inexperience of the owners, had become badly run down. George had been working hard during the six weeks of his stay there to get things in shape, while to add to his troubles, the manager had in a sudden penny-wise, pound-foolish fit of economy laid off the men who had been working there all summer, when their services could have been utilized to good advantage under George's direction. These men leaving town almost immediately had left him without any help, and while one good man can sometimes perform for a short time the work of three ordinary men, very few men have the physical strength to do so continually. Mr. Wilson was no exception, and the young man with the note, who had early in the summer worked with the gang as a ground hand, and later had been allowed to climb when the gang was in a rush, was sent as the result of a vigorous call for help.

It required but a glance at the red-headed, freckle-faced young fellow standing before him to see that he was no lineman.

"How long have you worked at the business?

"Since last May."

"How long have you been climbing?"

"I climbed almost steadily the last two months."

"Did you ever do anything but carry a wire up a pole and tie it in?"

"No, sir."

"Let me see your tools."

The young man produced a pair of new climbers and a belt with pliers and connectors attached.

"All right. Do you know what a cross is?"

"Why, yes. It is when the wires get mixed up together."

"Well, that is the correct idea, though it is not the way a lineman would say it. Let me see — this note does not give your name."

"William Harrison Butler, generally called Will for short."

"Very well, Will. The wind played havoc and shook in a large number of crosses last night, and as the simplest way is the quickest, you may take the D.-Street line, while I will follow out Pine Alley. Shake out all the crosses you see, and when you get out to J. Brothers' factory, you may call up '900,' which is the chief operator's number, and ask for further instructions. Be as lively as you can, for we have a lot of trouble in today, and we want to get out as much of it as we can before the subscribers find it out, for if a man fails to get one call over a telephone wire, he gets mad and tells his neighbors all about it; all of which goes to show that the telephone is an invaluable aid to modern business, and that they miss it badly when they don't have it."

Will started out very proud of the fact that at last he could be trusted to go out alone and do his work without some one to show him how at every step. He found quite a number of wires crossed on his way up, but by dint of active climbing he got up to J—— Bros.' factory in about an hour's time. Here another difficulty confronted him. In all his life he had never used a telephone, and had not the remotest idea of how to call "900."

But a young fellow with a red head and a quick wit will not be caught as long as his brain holds out. Walking into the office with an air of deference and modesty which did not belong to him, he said, addressing the head of the firm: "Mr. J., your telephone line was crossed up to a little while ago, and I would like to have you call '900,' and see if it is all

right. Of course I could do this, but I know you will be better satisfied to do it yourself, for then you'll know it is all right.''

Mr. J. was perhaps surprised at a telephone man's making such a request, but he readily complied, Will Butler meanwhile watching every move with the keenest attention. The line was all right, and Mr. J. told Will that he was wanted at the 'phone.

Who does not remember the queer feeling that comes over him the first time he uses a telephone; the strange sensation of delight and triumph that is almost childish and of which he feels ashamed, coupled perhaps with just a suggestion of fear as the words reach him from the distant station, and the strange wonder that comes over him as he realizes that his own hesitating answers are heard and understood, and realizes that he is now fairly in touch with twentieth century civilization? Those of us who use a telephone many times a day, and swear every time we have to wait five seconds for an answer, do not realize what a wonderful performance we are taking part in, one which is more wonderful to the scientist who understands the complex nature of sound waves than to anyone else and to whom the questions when first considered seemed impossible of accomplishment. Here the sounds, first translated into electrical vibrations, go whirling, vibrating, dancing over a wire that opposes their passage, meeting stronger currents that are coming to meet them, while others cross their path, and others still try, by going the same way, to crowd them off. Still they go on, dodging some, traveling arm in arm, as it were, with some, and riding over or through others like a strong swimmer in the surf, to reappear again as sound waves in their original shape.

No wonder the mathematician finds it difficult of explanation and gets lost in a maze of symbols. Young Butler, however, did not know much about this, and he had not long to consider it, for the chief operator reported all the lines on that lead ''clear,'' and sent him half a mile away to clear a ''grounded'' line.

Now, what is a ground? Will had often heard the linemen talking about grounds, but he had never learned just what they were, and now he was in a quandary.

Going over to the subscriber's place of business, he found that he could raise Central, and though the conversation was not perfect, he was still able to make himself understood, and he went out wondering more than ever just what was the matter with the line. He followed the line back to the office, but could not see it lying on the ground anywhere, and was no wiser than when he started out, but just then he met George coming in also.

''Say, what kind of a looking thing is a ground?'' said Will, thinking it better perhaps to confess his ignorance than to be accused of killing time.

''A ground,'' said George, ''is a connection with the earth, either by actual contact with the ground, which is the case when a wire is broken, or, what more commonly happens, it touches another grounded line or the iron framework of a building, or it may be crossed with its own return wire.

''In this office we have a common-return system, that is, each wire is connected to its telephone, then passes out of the other post and connects to a wire common to all of them.'' George drew a sketch (Fig. 1) showing how all the telephones were connected together in this system. ''In addition to that, for various reasons which we need not discuss now, this return wire is grounded, though this grounding is not necessary to the system, but still you see that if a wire were to come in contact with the earth it would be the same as though it were crossed with the return wire, which, of course, will prevent any current from reaching the instrument.''

''But I was able to talk from this place and ring Central,'' said Will.

''Well, that proves that your ground is not a very 'heavy' one,'' said George, ''or otherwise it would have cut you out completely. Of course, if the resistance of your ground is equal to or more than equal to the rest of your line, it follows that the current will divide and go both ways.'' Here George made another pencil sketch (Fig. 2)

showing a circuit grounded with a resistance of 150 ohms (a), while that of the farther end of the line was only 100 ohms. "Now you see it follows that the end of the line will get more current through closet pipes, etc., it would then be grounded, because these pipes are connected with the sewer and water main systems of the city, and, of course, are in this way well grounded.

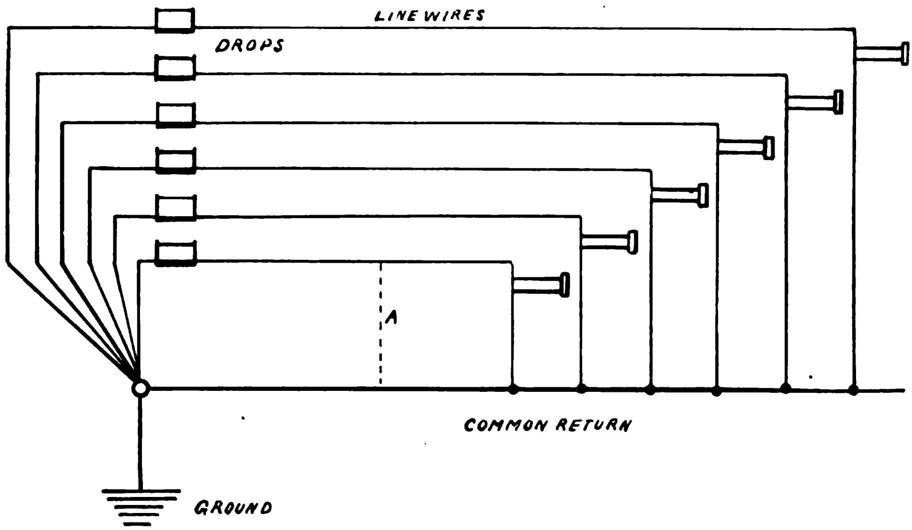


FIG. 1.

than the ground, and if the line is in otherwise good condition, conversation can still be carried on over it, but if the ground connection should be as low as 10 ohms, the telephone would then only get one-tenth of the current, which would most effectually cut off conversation."

"Then any kind of metal in contact with the wire would ground it?" remarked Will.

"No," said George, "not unless the metal itself is in contact with the earth. Thus a wire may sometimes touch a tin

"And also remember if you have to connect the instrument to earth — for in some places they do this instead of using a return wire — connect to water or gas pipes if possible, for then you have many hundreds of feet of earth contact, but more important still, the current follows the pipe right back to the office with practically no resistance. A water pipe is, however, better than a gas pipe, as they use red lead or sealing wax on gas pipe joints, which sometimes makes the resistance very high."

Just then they saw the wire lying

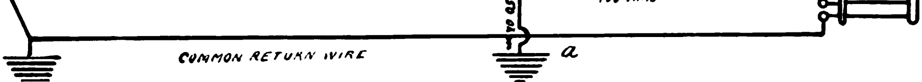


FIG. 2.

roof, and yet not show a ground, because the tin does not come in contact with anything but wood and brick, which are fairly good insulators, at least when dry; but if the roof should be connected with the plumbing of the building,

against a guy wire, which in turn was touching a water conductor from a building, and which was in turn connected through a cast-iron drain pipe.

"There is your trouble, said George, who noted all these points at a glance.

"The wire, you will notice, has slipped off the top of the glass insulator, and if you tie it back in place it will be all right."

Will did as he was told, and in a few minutes was on the ground beside George, who had watched his work.

"Now," said George, "we will go into this subscriber's place and make a test, for there may be other grounds on the line."

Entering the store, George proceeded to take one wire out of the binding post of the instrument with his screw-driver. When he had done so he held the wire against the post while he called Central, and asked her to ring, and at the first tinkle of the bell held the wire away.

"Did the buzzer ring?" asked George of the girl.

"No," said the girl, "it did not ring at all."

"All right," so saying he put the wire back under the binding screw.

"The line did not ring," said George, "which shows there was no ground on it when I had it open, so we know it is all clear. Had there been a ground, it would have rung in the office."

Will was kept so busy shaking out crosses and repairing wires during the next two or three days that he had little time for anything else, till one day, having been looking for a cross he could not find, he appealed to George to help him out.

"Let us first locate this thing," said that individual, who had meanwhile been busy renewing batteries and rewiring some old-style instruments. Going up to a wall set behind the board, he connected one wire to the common return wire, and removing a clip from the fuse block, inserted the other wire in the end next the board. A turn of the crank raised the operator, which showed that the trouble was not in the office cable. Placing the wire now on the other side of the clip, he tried the line end, and while the bell rang good and strong no one responded except the operator, who came in on the other wire. Taking down the receiver, he blew softly across the mouthpiece of the transmitter.

"That trouble is near by," he said.

Counting down to the cable number, he told Will to go outside and open that wire in the cable box.

When Will reported from the pole outside that he had done so, George rang up and got a closed circuit as before.

Looking over the cable terminals, he found a vacant one, which upon testing out he found open. Changing the cross-connecting wire from the faulty one down to the new conductor, he directed Will to make a like change outside.

When this had been done he tested again, and this time found the line all right. He now directed Will to take the binding screw out of the post just vacated and leave it on a shelf on top of the box, and in order that that post might not be used again, George on the inside made a cross with a pencil opposite the faulty one.

"Say," said Will, when he came in, "don't we have to change both of those wires? You know two lines were crossed."

"No," said George, "because as the two conductors are crossed together and do not show a cross with anything else, we, by using only one wire, make one conductor of the two, which does no harm."

"I noticed that you blew across the transmitter when you were making a test; how could you tell that way where to look for your trouble?"

"Well," said George, "that takes a great deal of practice, and besides you must know your lines, that is, you must be able to distinguish between static and trolley induction."

"Now listen," and George handed Will the receiver, short-circuited the instrument and blew across the transmitter mouthpiece, telling him to notice how clearly the disturbances on the diaphragm came back to his ears. Then changing to a long-line connection, he told him to observe the difference in sound. For the next few days Will practiced this method at every opportunity until he became nearly as expert as George. He also found that he could almost tell the distance to a break in an open line by the same method.

When he related this to George, thinking he had made a discovery, that indi-

vidual merely remarked that it was only the old static method of locating breaks in cables or telegraph lines, the only difference being that a telephone is more sensitive than a galvanometer, and that the ear does not register the disturbance in degrees of deflection. This, of course, was all Greek to Will, but as George seemed a little grouchy that day, he forebore asking for further information till he was in better humor. But one morning when the latter was unusually cheerful and work was not pressing, he took pains to approach him on the subject and asked what he meant by the static charge.

"Did you ever get a shock from the wires when you were working in the country?" asked George.

"Yes, lots of them;" said Will, "why sometimes when I was tying in I used to get very sharp shocks, but I always thought some one was trying to ring up on the line, or that we had crossed a telegraph wire, and more than once I got them by touching the bottom of the glass, and sometimes they came so hard that the men on the ground were almost knocked down by them."

"Well," said George, "that was one form of static charge, and the lines were not connected in, or you would not have felt it, but instead it would have gone through the telephone, and a person listening on the line would have heard a crackling sound. Now, this induction is from the earth or the air, or rather both together, and this is always opposed to the telephone current, and it is not easy to insulate. Perhaps you have noticed that the short lines placed on a pole alongside of a toll line will be almost as noisy as the longer one, because the static induction from the longer one affects the shorter. By the way, did you ever make any transpositions?"

"No, Lon Williams and Bailey did nearly all of that."

"Well, two of our toll lines are rather too noisy, and as we have not much to do today, we will get a team and drive out over them, and see if we cannot take out the noise. I will go around and see about the team while you get out the stuff. Take along about twenty of those double groove insulators, and about the same number of the ordinary kind, some pins, for we may find some broken, also the double blocks, and two 'come-alongs,' grips or eccentrics, as they are variously called, a hand ax and plenty of wire. And don't forget to take along a telephone and your regular linesmen's tools."

George went in to speak to the manager in regard to his trip, and to notify a livery stable to get out a team, as the manager's horse and buggy were away at the time. When he returned with the team he thought he might as well be prepared for a general inspection trip, so he added two receivers and two or three pounds of sal ammoniac to the material already in the buggy.

"Now," said George, when they were fairly on the road, "we will drive over this line and make notes of its condition and inspect the instruments, then what work needs to be done we will do coming back. You may, however, put on your climbers, so that if we see any broken glass we will lose no time."

The trip out was a pleasant one, and devoid of anything more exciting than the replacing of two or three broken insulators. Will knew the line fairly well, having worked with the gang on this section for a short time, but George had never been over it before, and made a note of everything he saw. Part of the way the line ran parallel to a trolley road for about a mile and a half, and in one place both the trolley feeder and the telephone wire passed through the same tree, and the limbs had chafed through the insulation on the feeder, while other limbs were brushing against the telephone wire.

"I should think the railroad people would keep their lines clear," muttered George, "that infernal limb will shunt enough current in the course of a year to run a car, besides making trouble for us. Go up and take that limb off. No, first clear the telephone line, and then clear the trolley feeder."

Will cut and broke limbs under George's direction until not a leaf remained near the telephone wires, the man on the ground removing them, twigs and all, to an obscure fence corner as fast as they fell.

"Now," said George, "remove that limb against the feeder, for that limb electrifies the whole tree and makes it bad for us. The trolley company will give us no credit for it, but we want it out of there on our own account. Cut that limb close to the tree and make a neat job of it. No, not that way. Cut it on the under side first, so that when it breaks it will not split out. Now, then, cut it on top."

"Here! Gol darn your pictures! Who in h—l told you you could cut that tree?"

Will had made two cuts on the upper side of the limb, and now paused with his hatchet in the air as if paralyzed, while George, who had half expected something of this kind, turned toward the newcomer, prepared to parley.

"Do you own this tree?" he asked calmly.

"Yes, I own this tree. Who told you to cut it?"

"Then I was misinformed, for a man I just met told me that this farm was owned by a man living in Detroit."

"Well, he's a dod-rotted liar. This farm is owned by me, and I want to know if your infernal corporation thinks they own the farms along here as well as the highway?"

"No," said George, "I well know that you farmers own the land to the middle of the road, but I was misinformed or I should have asked you. Now, will you tell me whether the little trimming we propose to do here will injure that tree in any way? We obtained the right of way along this road from the majority of the property owners, with tree-trimming privileges, and, supposing that it was all settled, we were simply trying to put our lines in better condition."

"Well, you never got any permission from me, and if you cut another limb I will have the law on you, and don't you forget it."

"Will you let us finish the limb we are at?"

"Not a dog-gone finish. Don't you cut another lick."

"Come down, Will," said George, seeing that further argument was useless.

"I am sorry that we made a mistake," said he, turning to the farmer, "and it shall not happen again."

"Well, see that it don't."

Getting into the buggy, they drove away, and when out of hearing Will remarked: "What a splendid bluffer you are."

"Well, I have been in this business for several years. In most cases I make it a point to get permission for this kind of work, but something told me we would get a great deal more by not asking."

"It is a pity I could not finish that limb."

"Well, the limb will die and drop off eventually, as it is half cut off anyway, and some day when we are passing along here we can throw a rope over it and assist nature in making away with it if the trolley people don't do it for us. Anyhow, our lines are clear."

"Now," said George, when they reached the point where the two lines separated, "there are only two transpositions of the line alongside this trolley road. When we get back here we will put in about six and see if that does not help matters."

"How do transpositions help matters?"

"First, by shifting sides to the trolley induction, so that both sides get an equal share of it, for if one side gets more than the other the line is thrown out of balance and becomes noisy, and the side next to the disturbing cause, the feeder in this case, always gets the most, but by constantly turning first one side and then the other both get an equal share, like a spitted chicken over a fireplace."

As George seemed to think this last remark funny, Will laughed, which put them both in good humor.

"Then again," continued George, "I told you something about the static induction; now, by turning the different sides toward the feeder we get a current that opposes the static charge. See?"

Will thought he did, and they arrived at their destination, eighteen miles from their starting point, before dinner. They had passed two toll stations on the way, at each of which they renewed the

batteries, though they were in fairly good condition, but George thought it easier to fix them up then than to make a special trip over the road for that purpose.

He also found that some of the carbon blocks in the lightning arresters had accumulated considerable dust, which had been caused by lightning flashing between them, and which, in one place at least, must have grounded one side of the circuit.

At each place he had tested the line back to the office, always opening it from the farther side, in order to listen on the line for induction effects, so that he could tell where transpositions were most needed. In one town the line ran close by a lot of electric light and telegraph wires in such a way that much of the noise at night was easily accounted for. He made four transpositions here, which, by testing the line with the instruments he had brought along, he found much improved the service. On the way back, as it was getting rather late, he put on a pair of climbers himself and helped Will to get the transpositions done, for he could easily work twice as fast as the young man, who was yet rather awkward, so that they made quite rapid progress, but in spite of all they could do it was long after dark before they returned to Independence, tired but thoroughly satisfied with their day's work, for they had trimmed trees, put on glass, inspected instruments, and cut in ten transpositions, besides driving over eighteen miles and back.

When the manager tested the line that night it was so quiet he could hardly believe his own ears.

NEW HONORS FOR THE AMERICAN ELECTRIC TELEPHONE COMPANY.

Another victory has just been secured by the American Electric Telephone Company, it having been awarded a medal and diploma at the Omaha Exposition. This makes the third medal awarded to this company in opposition to all independent manufacturers, and was the highest award given to any independent manufacturer at the Omaha Exposition.

EUREKA ELECTRIC COMPANY'S HIGH-GRADE APPARATUS.

The Eureka Electric Company, while a comparatively new concern in the telephone field, is already securing a prominent position before the trade. The company's rapid success is undoubtedly

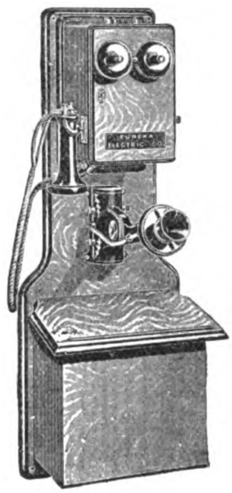


FIG. 1.

FIG. 2.

due to its policy of furnishing only the very best in any particular line of apparatus.

In the company's line of telephones are included all the leading types, one of the best and most efficient being the No. 40 set, shown in Fig. 1, the regular wall set, and in Fig. 2 the long-distance type. This instrument is equipped with the celebrated Williams magneto, full nickeled, having the new automatic shunt, single-core ringer and differential corru-

FIG. 3.

gated gearing. The induction coil used with this instrument is of the best quality, having fiber ends, silk-covered wire and soldered terminals. Fig. 3 gives a good illustration of the coil.

The transmitters used in these instruments are of the well-known solid-back type, and guaranteed as to efficiency and nonpacking qualities.

In the Eureka double-pole receiver,

FIG. 4.

shown in Fig. 4, the same care has been used in designing and construction, making it one of the handsomest on the market. It is furnished with a hard-rubber case and made adjustable. For magnetic strength and efficiency it is unequaled.

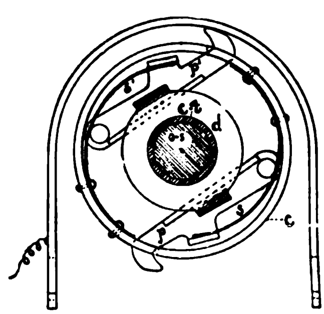
It is claimed by the Eureka Electric Company that its aim will always be to handle only the best of apparatus. The company's switchboard is claimed to possess new and distinct features, and, while of the highest grade, is sold at a reasonable price.

Descriptive matter, covering the complete line of Eureka apparatus, will be mailed free by the company upon application.

THE transmission by a telegraph company of a libelous telegram, and its delivery in writing at destination are held, in Peterson *vs.* Western Union Telegraph Company (Minn.), 40 L. R. A. 661, to constitute a publication of the libel.

A NEW AUTOMATIC MAGNETO SHUNT.

The accompanying illustration shows a new and unique way of automatically shunting the armature windings on exchange magneto bells. *G-S* represents the gear shaft, which is shown in section at a point near the driving-dog *d*, which is riveted and brazed on to the crank-tube *c-t*, which is also shown in section. *P* and *p'* are two pawls which are mounted upon a brass cup-shaped disk *c*, and which are actuated radially outwardly by two flat steel springs *s* and *s'*. Either one or both of these pawls while in their normal condition press against a contact band *a* which is mounted on the pole-pieces, so that its curvature is concentric with the gear shaft and insulated by means of hard rubber blocks and are electrically connected with the commutator end of the armature coil. The pawls are electrically connected with the other end of the armature winding through the frame of the magneto generator. To break the shunt or short-circuit, as in the operation of turning the crank, driving-dog *d*, which has two laterally extended ears, as shown by the shaded portion, engages two upwardly turned flanges of pawls *p* and *p'* and pulls them radially inwardly, thus breaking the contact between them and the insulated band *a* until they engage or lock on the



A NEW AUTOMATIC MAGNETO SHUNT.

gear shaft, when the further movement of the crank rotates the armature and generates current, which is delivered to the line wires. The patent on this device is owned by the Williams Electric Company, of Cleveland, Ohio, who use this form of automatic shunt on all of their high-grade exchange magneto bells.

RECENT PUBLICATIONS.

"In the type-case of the printer, all the wisdom of the world is contained, which has been or ever can be discovered. It is only requisite to know how the letters are to be arranged. So, also, in the hundreds of books and pamphlets which are every year published about ether, the structure of atoms, the theory of perception, as well as on the nature of the asthenic fever and carcinoma, all the most refined shades of possible hypotheses are exhausted, and among these there must necessarily be many fragments of the correct theory. But who knows how to find them?

"I insist upon this in order to make clear to you that all this literature, of untried and unconfirmed hypotheses, has no value in the progress of science. On the contrary, the few sound ideas which they may contain are concealed by the rubbish of the rest; and one who wants to publish something really new — FACTS — sees himself open to the danger of countless claims of priority, unless he is prepared to waste time and power in reading beforehand a quantity of absolutely useless books, and to destroy his readers' patience by a multitude of useless quotations."—HELMHOLTZ.

PAINTING ON METAL, WITH SPECIFICATIONS. By A. H. Sabin. 80 pages, 3 by 6. New York: Edward Smith & Co.

This neat little book discusses in an instructive manner the correct method of painting metal surfaces, and furnishes the engineer with carefully drawn specifications for the proper prosecution of the different processes connected therewith. Recognizing that iron and steel are perishable materials, great stress is laid upon the necessity of properly preparing the metal for the reception of the paint, the several schemes to that end — such as sand blasting, "pickling" and brushing — being fully entered into, and their relative advantages and disadvantages set forth. The enormous amount of structural ironwork which is being erected in these days brings forcibly before us the importance of this subject, to which so little attention is too often given.

CHAUNCEY G. HELLICK.

DIE LEHRE VON DER ELEKTRICITÄT. Von Gustav Wiedemann. Vierter Band. Friedrich Vieweg und Sohn. Braunschweig. 1,237 pages, 6 by 9; 269 illustrations; paper, uncut; price, 32 marks.

This fourth volume brings the work of Prof. Gustav Wiedemann to a close, while Prof. Eilhard Wiedemann will add a fifth volume wherein the discharges in gas, with which Röntgen's researches are so closely connected, will find a separate treatment. The contents of this fourth volume comprise mainly "induction," beginning with a chapter on induction in lineal conductors. The experiments of Faraday, Henry, and other physicists that gained fame by their investigation of this subject, are recorded very minutely, and followed up by the theory, mathematical as it is.

The induction coil and the condenser offer a great field of exploration for the experimental as well as for the mathematical physicist. It is these two instruments that have helped Hertz and his followers to remove the last doubt about the fallacy of "action at a distance" theory, to which the deepest thinkers of the German school adhered so tenaciously. A fuller record of these experiments can only be found in the original records of the same. This general and exhaustive chapter on induction is succeeded by the description of induction apparatus coincident with a discussion of the application of the laws of induction to the construction of dynamo-electric machinery, to which, however, only a comparatively short space is allotted.

About one hundred and fifty pages are devoted to the absolute measurement of electrical constants, containing a full account of the various ways in which units have been determined.

The final chapter is theoretical, being entitled "Hypothetical Views of the Nature of Electricity and Its Actions." The theories of Maxwell, Helmholtz, Hertz, Heaviside and others are reviewed without partiality and in a connected succession. A list of the books and publications containing the original investigations and writings of the above writer is added, in order to enable the student to judge for himself.

The table of contents and names at the end is remarkable for its quantity as well as for its quality, and may be considered a treatise by itself. It certainly is a treat.

It must be conceded that today there exists no manual on electricity so expansive and so thorough as the one just finished by Professor Wiedemann. It is, indeed, an encyclopedia of electricity, and deserves to be as fully appreciated outside of the borders of its fatherland as it is inside of them. This "Lehre von der Elektricität" is the incorporation of genius, perseverance and industry.

CHAUNCEY G. HELLICK.

THEORY OF ELECTRICAL MEASUREMENTS. By William A. Anthony. New York: John Wiley & Sons, 1898. 12mo., VI, 90 pages; cloth; price, $1.

This little book was prepared for the third year classes of the Cooper Union (New York) Night School of Science, and contains notes and data bearing upon the lectures in connection with which it is intended to be used.

The fundamental principles governing the making of electrical measurements are briefly stated, and the usual methods of performing those most common, with the theory, given in some detail. Problems are inserted and applications indicated throughout the book.

Although the work contains nothing new, and the author, in the choice of terms, at times does not adhere closely to the best usage, as for example in the expressions, "conductivity is the reciprocal of resistance," "permeability is the reciprocal of reluctance," the notes will doubtless be found useful to the instructor as a guide, and to the student for reference.

CHAUNCEY G. HELLICK.

ELECTRO-DYNAMICS; THE DIRECT-CURRENT MOTOR. By C. A. Carus-Wilson. London: Longmans, Green & Co., 1898. 298 pages, 5 by 7; cloth; price $1.75.

The direct-current motor, though in many fields displaced by its more progressive rival actuated by alternating currents, is still of sufficient importance to make its study both interesting and profitable. In railway, elevator and kindred applications, the continuous-current motor remains preëminent, and anything that will assist us in readily solving the numerous problems presenting themselves in these broad fields should be gladly welcomed. A real help to this end is found in the treatise which Professor Carus-Wilson has just given us. In this work, the principles of electro-dynamics are applied to the solution of motor problems, and while a general acquaintance with electrical fundamentals and the design of motors are presumed, the subject is developed in a sufficiently simple manner to be of service to engineers generally.

The author starts out with the induction factor of a dynamo — the ratio of the induced tension to the number of revolutions per second — and shows how convenient a factor it is in the calculations following. Chapters on shunt-wound and series-wound motors, and efficiency, containing much that is new, precede a very instructive chapter on acceleration, wherein are given methods of finding the torque available for acceleration as distinguished from the total torque and the speed at any instant. As the ordinary method of rating a motor in horse-power tells us nothing of its ability to accelerate, a new concept is introduced, the *force factor*, the product of the current and the induction factor. This measures the work done per revolution, and is a convenient unit for comparing dynamos of different types. The chapter on speed control brings out the several methods commonly employed, and is illustrated by numerous practical examples. The design of railway motors, chiefly the determination of the best arrangement for starting up from rest and covering a given distance in a given time, is treated in a masterly manner. A chapter on armature reaction and a large number of problems following complete the book. Graphical methods of illustration are employed throughout, some seventy figures being included for the purpose. The only possible criticism on these well-drawn curves arises from the fact that they have been reduced to such an extent as to make them difficult to read, the typography otherwise being excellent.

Professor Carus-Wilson's contribution is a distinct gain to electrical literature, and should be in the possession of every engineer.

CHAUNCEY G. HELLICK.

1899 COLUMBIA CALENDAR.

The Fourteenth Edition of the Well-known and Very Useful Little Memorandum Pad Makes its Welcome Appearance.

The fourteenth annual edition of the Columbia Desk-pad Calendar, issued by the Pope Manufacturing Company, of Hartford, Connecticut, is being distributed. This calendar occupies a unique place among advertising devices. It may be said to be largely the product of the Pope Company's own customers, whose contributions in the shape of fitting testimonials to the merits of Columbia product, or clever bits of verse about bicycling in general, appear at the tops of the various pages over the names of the contributors. The pages for Sundays, the first day for each month, and holidays, present appropriate selections from well-known authors.

Any person may obtain a copy by applying to the nearest Columbia dealer or by sending five 2-cent stamps to the Calendar Department, Pope Manufacturing Company.

INDEPENDENT ITEMS.

TROY, KAN.—A telephone line from Troy to Burr Oak is under consideration by local parties.

LEXINGTON, VA.—A telephone line will be built from Lexington to Natural Bridge, Virginia.

SAGINAW, MICH.—The Valley Telephone Company has opened an exchange at Clio, Michigan.

NEWTON, PA.—The Standard Telephone Company has been granted a franchise and will soon commence the building of an exchange.

HARTFORD, KY.—The new independent telephone exchange is nearing completion, and will be opened for service within the next thirty days.

PULASKI, N. Y.—Dr. F. A. Box, C. Tollner and W. F. Place are at the head of a company which is erecting a telephone line between here and Port Ontario.

GERMANTOWN, MD.—The Germantown, Minerva & Maysville Telephone Company has been incorporated by J. F. Walton, S. D. Rigdon, I. Woodward and others.

NEW PHILADELPHIA, OHIO.—The Tuscaroras Home Telephone Company has been incorporated by James S. Bailey, Jr., E. V. Bainbridge, John W. Yeagley, and others. The capital stock is $91,000.

ARMOUR, S. D.—Arrangements have been completed for telephone connection between this place and points west and south. A line will run to Greenwood, thirty miles south, and also to Edgerton and Wheeler, west on the Missouri river.

PADUCAH, KY.—A franchise has been granted the American Electric Telephone Company, which will at once commence the construction of a first-class modern exchange. Over four hundred subscribers have already been secured.

KALAMAZOO, MICH.—The Kalamazoo Mutual Telephone Company has issued its new directory, which is a finely gotten up work and contains over seven hundred names of local subscribers besides giving the names of all the subscribers in Plainwell, Otego, Paw Paw and Vicksburg.

NEW LONDON, IOWA.—A telephone line between this place and Lowell is about to be built by E. A. Stephenson, of Lowell, and G. M. Van Susdall and J. E. Peterson, of New London. A company has been formed under the name of Henry County Telephone Company, and work will be commenced at once.

CHILLICOTHE, ILL.—A new independent telephone line has just been completed in Peoria and Marshall counties, connecting Chillicothe, North Chillicothe, Hallock, Lawn Ridge, Edelstein, West Hallock, La Prairie and Sparland. Connections will soon be made from Sparland to Lacon, where intercommunication may be had with several towns in Woodford, Marshall, Livingston and Putnam counties. Tim Van Antwerp, of Sparland, is the promoter.

BLACKSBURG, VA.—The Montgomery Intelligence Company has just completed two exchanges in this and adjoining counties. The boards have a capacity of fifty lines each at present, and are of the well-known American "Express" type. Some thirty miles of toll lines have been completed, and more work is being contemplated. The officers of the company are: Hon. A. A. Phlegan, president; Aaron Graham, treasurer and manager, and L. H. Lancaster, electrician.

WACO, TEXAS.—War has been declared by the citizens against the Southwestern (Bell) Telephone Company, and an independent exchange will, no doubt, be in operation at an early date. The Independent Mutual Telephone Company has been formed by E. Rotan, J. B. Earle, S. Sanger, E. E. Dismuke, J. E. Boynton and Ed N. Stephenson, who propose to build a 1,000-line exchange. Over four hundred subscribers have already been secured, and 300 more are practically sure.

MONTHLY DIGEST OF TELEPHONE AND KINDRED PATENTS

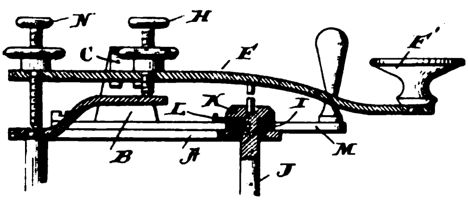
EDITED BY EDWARD E. CLEMENT.

Copies may be had by inclosing 5 cents and postage for each one. Address inquiries in care of this magazine or to McGill building, Washington, D. C.

October 4.

611,919.—F. E. LEWIS. TELEGRAPH KEY.

This is a key of the ordinary type, having its base formed of sheet metal—presumably a stamping. The main body

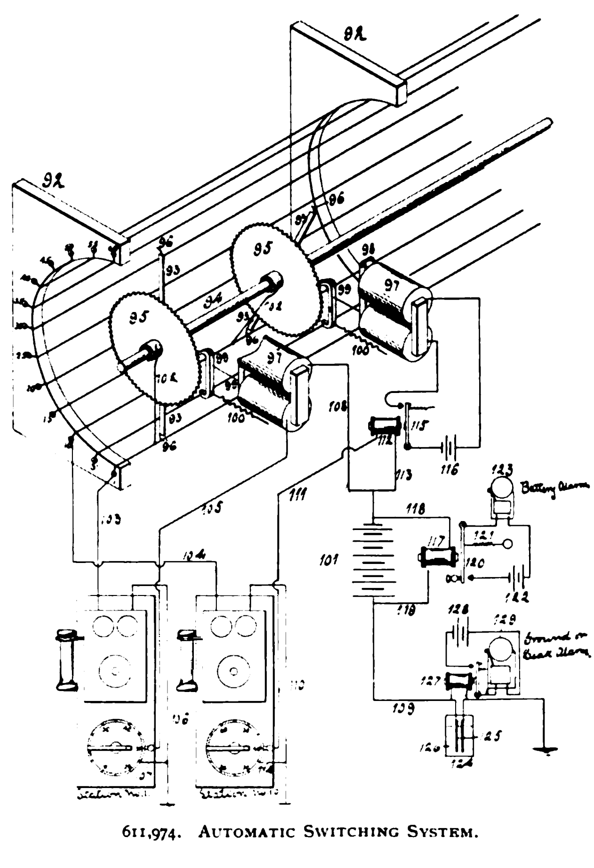


611,919. TELEPHONE KEY.

of the base is of annular form, with side projections and an inner forwardly projecting tongue, all integral. The side projections are bent up to form posts for the lever, the ends being bent over and notched. The tongue is bent up and forms the spring. The key lever has pointed trunnions which lie under the bent-over ends of the posts, with their points resting against the posts to prevent side motion, and the spring holds the lever up. The ordinary anvil, with insulated bushing, is provided, together with a short-circuiting switch.

611,974.—L. G. NILSON. AUTOMATIC SWITCHING AND TELEPHONE SYSTEM.

This is a system, with special apparatus, whereby any subscriber may connect himself for conversation to any other, without the interposition of an operator. The central station apparatus consists of as tep-by-step motor for each line, adapted to move contact arms around into such a position that they will engage the desired one or ones of a series of parallel circularly grouped line terminals. In case of metallic circuits one wire of each metallic circuit, and the ground, are used for the signaling circuit. The transmitter consists of a setting arm, whereby a spring may be wound to cause a toothed wheel to follow the arm, making and breaking the circuit through the intermediation of a contact pen bearing on its teeth. The setting arm controls a detent while setting the desired number for transmission, which detent prevents the wheel from starting until the arm is fully set. At the central office a low battery alarm and a leak alarm are provided. The former is simply a relay, held up as long as the battery is up to proper strength; and the latter consists of a small storage cell connected in the



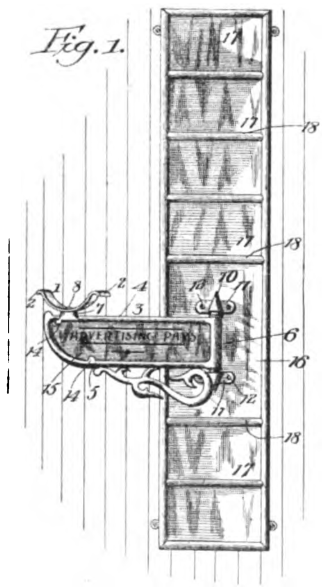
611,974. AUTOMATIC SWITCHING SYSTEM.

signaling circuit and shunted by a relay. As long as only normal use of the apparatus goes on the cell does not become charged; but if there is a leak or if some circuit-closing part becomes deranged the constant current charges the cell and the relay attracts its armature to close the local alarm circuit.

October 11.

612,172.—J. R. McKELVEY. TELEPHONE ARM REST.

The figure is almost self-explanatory. The lugs 14 and the slot 13 are to hold an advertising card. The pintle has cone bearings.



612,172. TELEPHONE ARM REST.

617,192.—F. E. CHANDLER. HINGE CONDUCTOR FOR ELECTRIC CURRENTS.

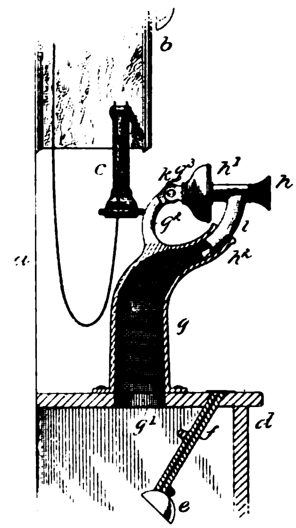
This is a hinge with a hollow pintle or rivet having a wire run through it. The ends of the wire are soldered to the two wings of the hinge.

612,219.—J. H. WEST. TELEPHONE CENTRAL STATION APPARATUS.

This is an arrangement of busy signals for multiple switchboards. A metal framework carrying lamps — one for each line — is provided, and itself forms a common return for all the lamp circuits. Each lamp circuit is closed when its annunciator is operated, or when a plug is inserted and spring contacts thereby bridged in any one of its multiple jacks. The lamp board is placed where all operators may see it, and may be a transparency with numbers.

612,330.—W. GRAY. TELEPHONE PAY STATION.

The invention in this case relates to the familiar class of devices wherein signals, such as bells, are sounded by the im-



612,330. TELEPHONE PAY STATION.

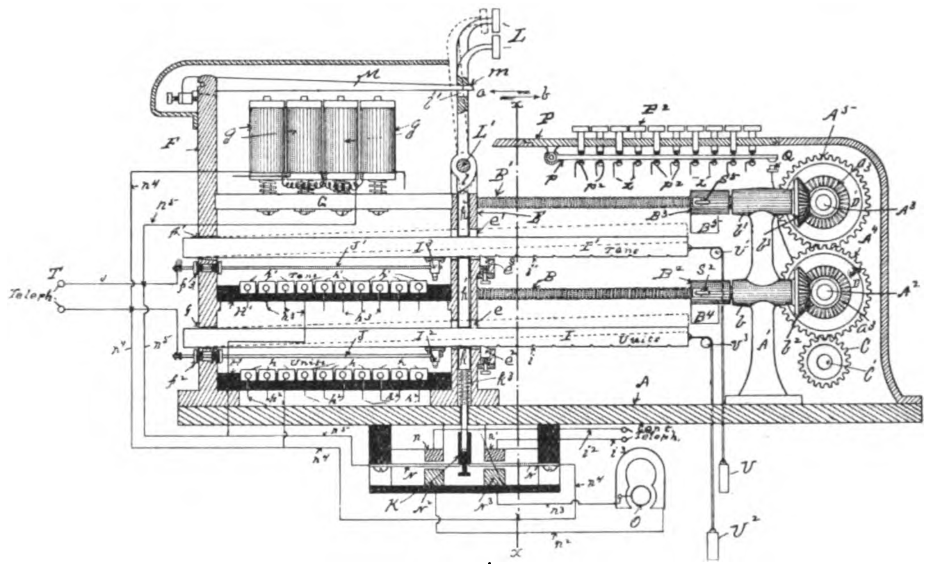
pact thereon of coins deposited in chutes. It consists essentially of a hollow supporting post for the transmitter, with a curved opening to receive a sound-conveying tube attached directly to the transmitter shell. The center of curvature of these parts is in the pivot of the transmitter, the play of which is limited by a stop.

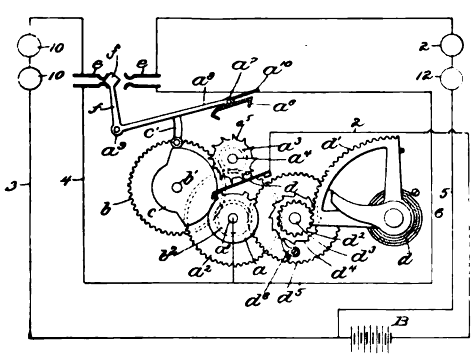
October 18.

612,681.—H. P. SNOW. TELEPHONE EXCHANGE MECHANISM.

This is what may be termed a "semi-automatic" exchange system and switching mechanism — that is, one wherein the subscriber, as in ordinary systems, notifies an operator of his want, but the operator, instead of selecting the wanted line, starts a machine which performs the selection and completes the operation. The arrangement is ingenious and well thought out. It consists of a series of tens and a series of units bars rigidly

fixed, with a series of tens and a series of units contact bars overlying and movable across them. Each subscriber is connected in parallel to the proper pair of bars, corresponding to his number, in each coöperating series, to a drop magnet controlling, through a cam lever, the individual movable bars, and their engagement with the mechanical shifting means, and lastly to springs playing between contacts in the operator's and calling generator circuits. The shifting means consists of a power shaft carrying bevel gears, and clutch mechanism shifted to cause two screw shafts to be driven in reverse directions. These screw shafts carry nuts which shift whatever contact bars are in their path. When a subscriber rings up, his drop magnet releases its drop, which allows his pair of movable bars to rise into the path of the traveler, and at the same time permits his contact springs to connect his line with the operator's circuit. When the operator learns the number desired she presses a units and a tens button corresponding thereto, whereupon the clutch is operated to connect the screw shafts, and the nuts and traveler advance, shifting the subscriber's contact bars until they rest on the rigid bars of the wanted subscriber. The operator then restores the drop, pushing it farther than necessary for simple restoration. This depresses the subscriber's contact springs upon the calling generator terminals, and calling current is sent out. When the subscribers ring off, the drops are again released, the bars raised, and as the nuts and traveler have been automatically withdrawn are permitted to be restored to normal position by suitable weights.


612,681. TELEPHONE EXCHANGE MECHANISM.


612,708. ELECTRIC SIGNALING APPARATUS.

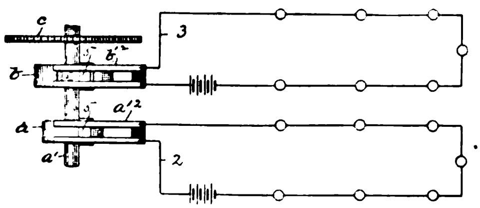
612,708.—W. E. DECROW. ELECTRIC SIGNALING APPARATUS.

This invention relates primarily to fire telegraphs. The ordinary time required for getting in a complete round of a signal on circuits containing tower bells, large gongs, etc., is so much of

what is required for getting out an engine that many schemes have been proposed to send an advance signal over the same or a separate circuit, which shall be rapid in its transmission. The present invention has to do with such an arrangement, where two or more circuits are employed. The same box mechanism is adapted to transmit first a fast signal, as shown, over circuit 3–4; then, when the cam *c* has made a half revolution, and the signal wheel *a* has made two complete revolutions, the lever a^8 drops, the escapement a^6 engages the star wheel and retards the train, the switch *f* closes the other circuit 5–6, and a slow signal of two rounds goes over the second circuit.

612,709.—W. E. DECROW. ELECTRIC SIGNALING APPARATUS.

The invention in this case is for the same purpose as that in 612,708, but here two signal wheels are employed,



612,709. ELECTRIC SIGNALING APPARATUS.

driven simultaneously, one having short teeth and intervals, and the other long ones. One controls circuit 2 and the other circuit 3, the fast and slow signals thus being sent at the same time, and by a single operation.

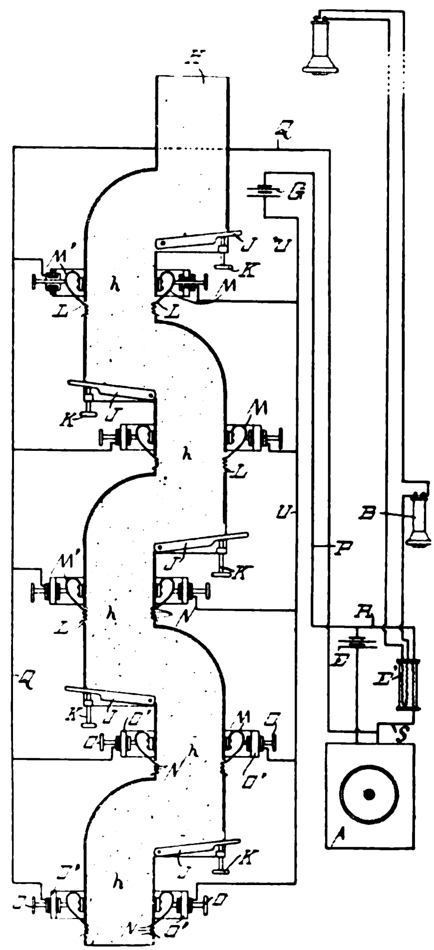
612,782.—H. R. MASON. COIN-ACTUATED SIGNAL APPARATUS.

The invention here consists in a chute for coins at a telephone pay station, circuit closers L being arranged to be successively actuated by a coin in its passage. These circuit closers are connected in parallel across a branch of the primary circuit, thus producing clicks in the operator's receiver as they are operated, the number of clicks determining the denomination of the coin. The chutes are provided with elbows to retard the descent after each closure.

October 25.

613,036.—C. S. HEILMAN. TELEPHONE EXCHANGE SYSTEM.

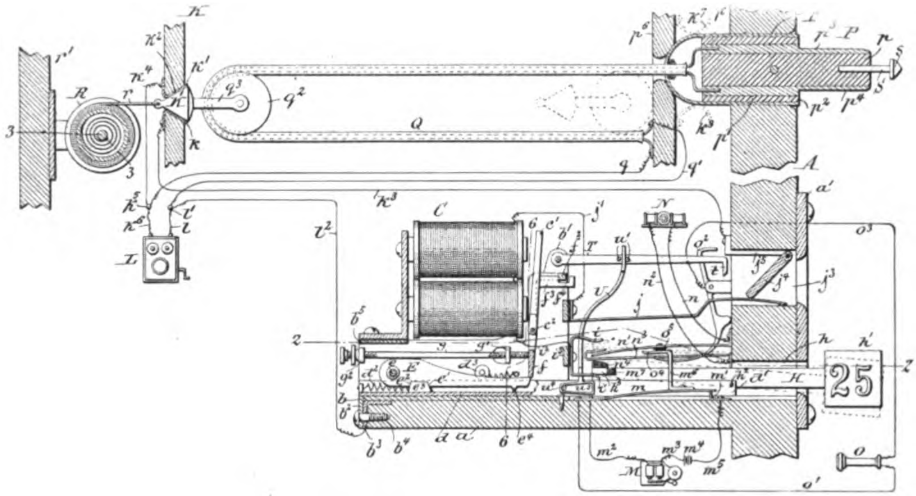
The invention in this case resides particularly in the switchboard construction. Each subscriber has a coupling plug P^3, a socket or jack j^3, a plunger signal h', and a controlling magnet C. The plug cord in each case has a retractor R, combined with a switch contact K',



612,782. COIN-ACTUATED SIGNALING APPARATUS.

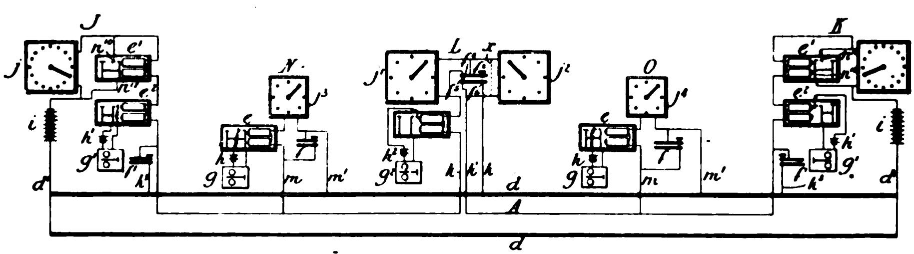
which normally completes the signaling circuit. When the subscriber calls, the plunger is projected, and by depressing it the operator can connect her telephone O. Having ascertained the number desired, the plunger thereof is depressed to cut in the generator, and then the calling line's plug is drawn out, incidentally

breaking its signaling circuit, and inserted in the wanted jack, being there detained by the hook *t*. When the subscribers are thus connected one magnet



613,036. TELEPHONE EXCHANGE SYSTEM.

C is cut out, and the other, whose plug remains seated, is still available for clearing out. When the ring-off signal is given, the plunger and plug are projected and the parts are restored by the operator. Provision is also made for trunk line interconnection of switchboards by



613,080. TELEGRAPHY.

similar means. The operators, in this system, cannot listen in without being detected.

613,080.—C. D. AND W. A. ROYSE. TELEGRAPHY.

This is a railway telegraph system, having an insulated rail and collector brushes on the car trucks. The system is, however, adapted to any way station work. Heavy opposed batteries are provided at the opposite ends of the line, and relays in line, both in series and in multiple. Way station keys are arranged to shunt resistances, and terminal relays shunt similar resistances, in order, when shunts are broken, to reduce the amperage of the line so that line relays can retract quickly. Way station relays are normally attracted, and terminal station relays are normally retracted, but all sounder circuits are normally open. Opposite conditions are thus utilized in signaling in different directions. For adjusting relays, windings in layers are utilized, more or less of the windings being cut in or out instead of resistance, as desired.

WESTCHESTER, PA.—The Chester County Telegraph and Telephone Company has its system nearly completed, and will soon be ready for operation. The branch offices in Coatesville and other towns will be placed soon.

TRADE NOTES.

WESTERN ELECTRIC COMPANY is sending out a bulletin giving a full description and price list of the Western Electric nonsparking brushes. These brushes are very satisfactory in eliminating the sparking at the commutator. Upon request a copy of this bulletin will be sent to anyone who has not received one.

THE Stromberg-Carlson Telephone Manufacturing Company, it is said, has worked out a strictly multiple switchboard with a thoroughly reliable busy test that they will put on the market early next season in connection with their central energy system. They claim they will be in a position to furnish full exchange equipment of the most modern type for any size exchange.

THE Farr Telephone & Construction Supply Company is now issuing regularly its monthly bulletin of all new and good things in the telephone supply and construction line. From the simple oak pin to the most elaborate switchboard the purchaser will find everything listed, all of the highest quality and at reasonable prices. The company's new series and bridging magnetos, recently placed upon the market, are meeting with unusual success, and are no doubt the best that can be produced for a fair price. It is undoubtedly due to the company's policy of always placing the lowest price consistent with reasonable profit upon its goods that its trade has so rapidly increased to the enviable proportion it now has.

Electrical Engineering
And Telephone Magazine

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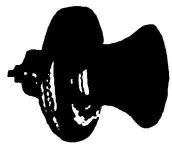

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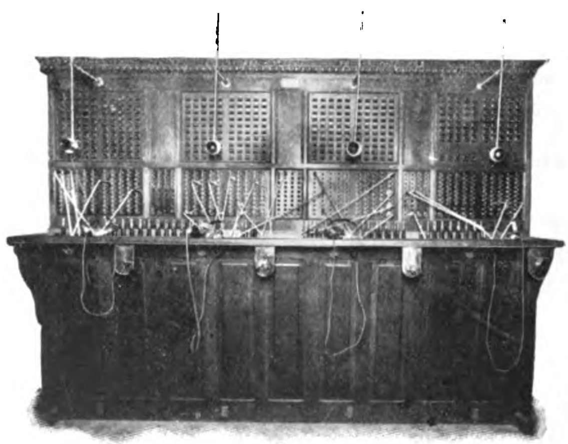

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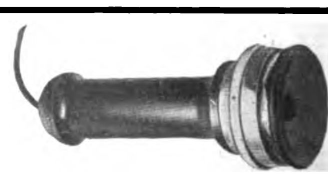

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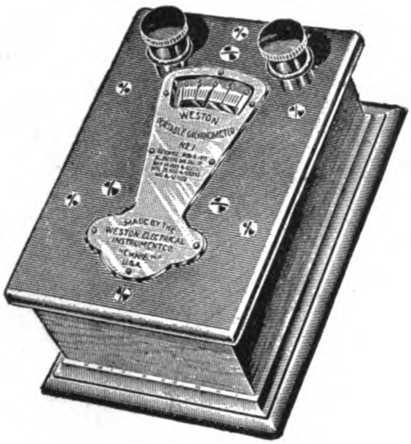

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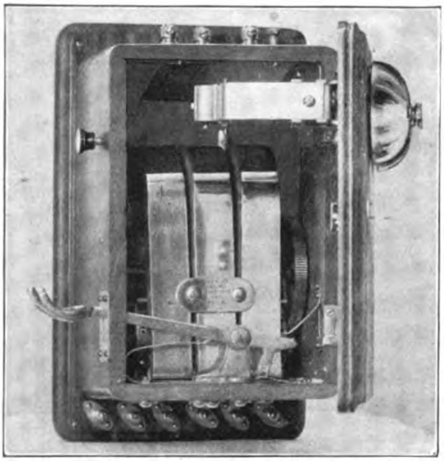

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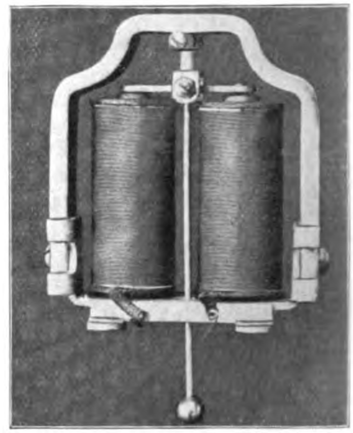

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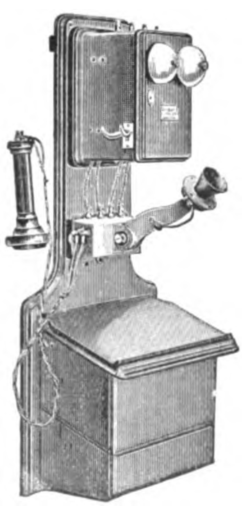

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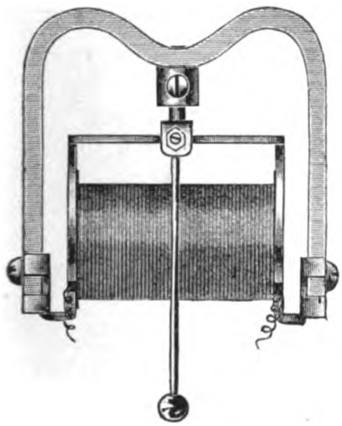

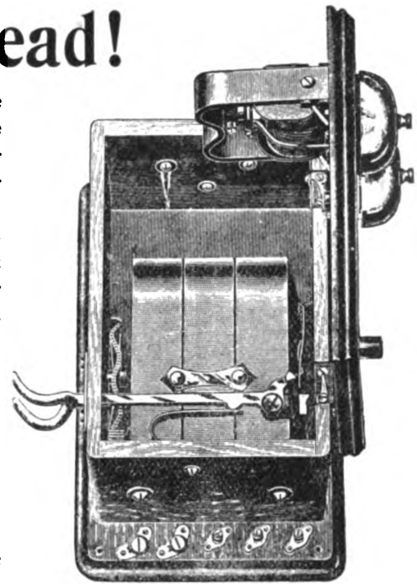

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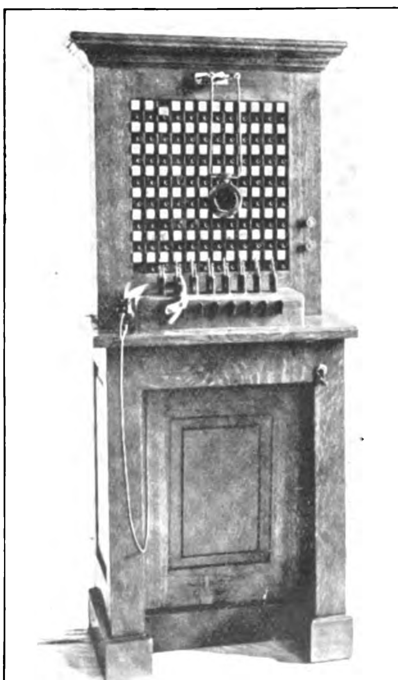

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PARTY LINES.

V.—BY KEMPSTER B. MILLER, M.E.

STRENGTH AND POLARITY SYSTEMS — CONTINUED.

A system devised by Mr. W. W. Dean, now of the Western Electric Company, and based on the same principles as those of Hibbard and McBerty, but adapted for eight stations instead of four, as in each of those systems, is shown in Fig. 5. The Hibbard and McBerty systems may be called polarity systems only, the strength of the current playing no part in the selection of the particular station to be called. The Dean system, however, is one of the few examples of a true strength and polarity system — that is, one depending on both the polarity and on the strength of the current. In this system four stations are associated with each branch or limb of a metallic circuit line. The two call bells on each of the limbs at the four stations farthest away from the central office are oppositely polarized and bridged between the respective line wires and ground, in exactly the same manner as in the four-party lines of Hibbard and McBerty. In fact, the four stations at the farthest end of the line from the central office may be considered, so far as the signaling is concerned, as the counterpart of those systems already described. The two call bells on each limb at the four stations nearest the central office are low wound and placed in the line wires. They are also oppositely polarized. A relay is provided for each limb, each having a high-resistance magnet and bridged to ground at a point between the two high-resistance bells and the two low-resistance bells on each limb. Each of these relays, when operated, serves to ground the opposite limb of the line at that point.

The principle of operation of this system is that a current adapted to ring one of the high-resistance bridge bells at one of the four more remote stations will not be of sufficient strength, owing to the high resistance of the circuit, to ring one of the low-wound series bells at the four nearer stations. Therefore, under ordinary circumstances any one of the four stations having bridged bells may be called by exactly the same method as those described in connection with the Hibbard system. When, however, one of the four nearer stations is to be called, the relay on the limb to which the bell of that station is not attached, is actuated. This grounds the limb of the line on which the desired bell is placed and therefore cuts out the high resistance bells on the farther end of the line. A current of proper polarity is then sent over this limb, which current is now capable of ringing the desired bell on account of the low resistance encountered. This method of doubling up the capacity of a line by such simple means is characteristic of Mr. Dean's work in general, he being responsible for some of the most unique, and at the same

time thoroughly practical, inventions connected with the telephonic art during the past few years.

A consideration of Fig. 5 will make clearer the operation and details of this system, and will also throw some light upon a very ingenious system for centralizing transmitter batteries, in which line Mr. Dean has done much work. 1, 2, 3, 4, 5, 6, 7 and 8 represent the subscribers' stations on a metallic circuit, composed of wires *b* and *c*. K and K^1 e^1 and e^2 are bridged between the limb *b* of the line and ground. A current from the negative side of the generator, if sent over the limb *b*, will therefore actuate bell e^2, e^1 not being actuated on account of its not being responsive to currents in that direction. This current will also traverse the ringer coils e^5 and e^6 at stations 5 and 6, but will not operate them because too feeble, these bells being wound to a rather low resistance and also shunted by a dead resistance in order to

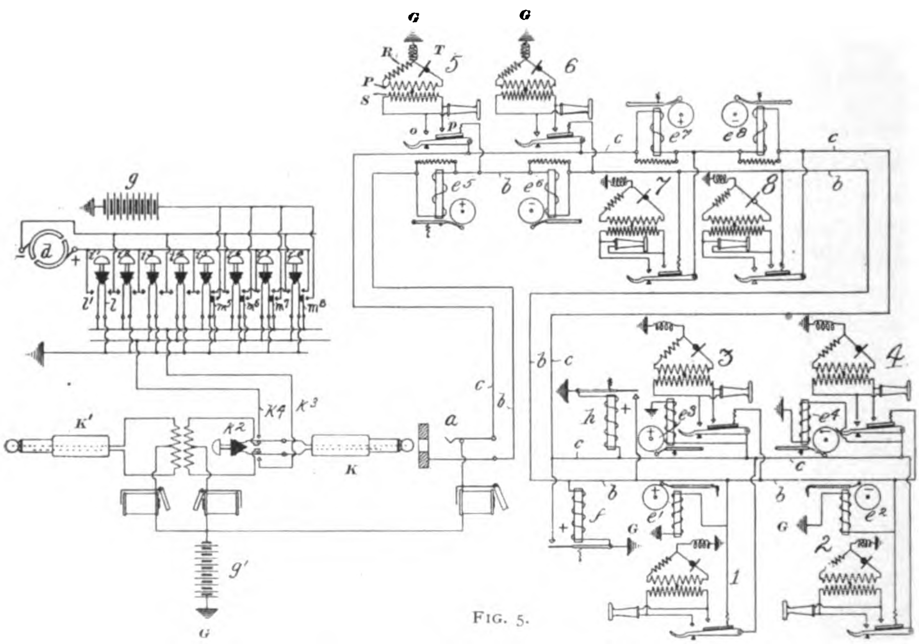

FIG. 5.

represent the calling and answering plugs respectively at the central office; *g* is a battery or other direct-current generator, while *d* is a generator from which pulsating currents of either positive or negative polarity may be taken as desired; l^1, l^2, l^3, etc., are keys adapted to send positive or negative pulsating currents, or direct current from the battery *g* over either side of the metallic circuit to which the plug K is connected by being inserted into the spring jack *a*.

At stations 1 and 2 the positively and negatively polarized high-resistance bells further reduce their sensibility. Suppose, however, station 6 is to be called; the operator first sends a direct current from the battery *g* over the line wire *c*, which current operates the relay *h* and causes it to hold its contact points closed. This, as will be seen, grounds the limb *b* at a point between the first high-resistance bell and the last low-resistance bell on that limb. A pulsating current from the negative side of the generator is then sent over the limb *b*, which passes through bells e^5 and e^6 and to ground at the relay *h*. Inasmuch as

this current does not encounter the high resistance of the bell magnets beyond, it has sufficient strength to operate bell e^6, but does not operate bell e^5 because it is of the wrong polarity. The selection of any station whose bell is connected with the other limb c of the line is performed in exactly the same manner. The ringing keys l^1 to l^8, inclusive, are so arranged that pressure upon any one of them will send the proper current or currents to line. For instance, depressing l^1 will ground the negative side of the generator and connect the positive side with the limb b, which will therefore call station No. 1. If one of the buttons designed to ring the four nearer stations is depressed, it will, besides sending the proper pulsating current to line, also send the direct current from battery g to the opposite line, in order to operate the relay f or h as the case may be.

Although not forming a part of the selective signaling system, the arrangement for accomplishing the centralization of all transmitter batteries will be described, because it is of much general interest. The battery g^1 is connected to the centers of both sides of an induction coil placed in the cord circuit. Suppose the receiver of station 5 to be removed from its hook, the current from g^1 will proceed to the center of the induction coil in the cord circuit, where it will divide, passing in parallel over the two wires b and c of the line. It will then pass to the contact points o and p of the switch hook, and to the center point of the secondary of the induction coil at station 5. Here it will again divide, one-half passing through the transmitter T, and the other half through the resistance coil R to the ground at G. The coil R has the same resistance as the transmitter T, under normal conditions. When, however, the resistance of the transmitter T is lower, the greater portion of the current will flow through it, and a smaller portion through R, giving the equivalent of a current from left to right in the primary coil P of the induction coil. This will induce a current in the ordinary manner in the secondary, which will pass over the line and affect any other receiver connected with the circuit. An increase in the resistance of the transmitter T will produce an opposite result, thus causing an induced current in the opposite direction to flow in the line. Thus while the current from battery g^1 produces no effect on the apparatus in the line under ordinary circumstances, it supplies the current for the local circuit of a station which, when operated upon by the transmitter, affects inductively the secondary circuit connected with the line.

A system which is being put into practical operation, and is apparently meeting with much success, was recently devised by Messrs. Barrett, Whittimore & Craft. It depends for its operation on the sending of currents of either polarity, or different combinations of currents, over either or both of two line wires in combination with each other or with the ground. Thus calling one line wire A and the other B, and representing the ground by G, it is evident that without using wire B at all, a current could be sent over wire A with a ground return in either direction, thus giving means for two selective signals. Similarly leaving A out of the question, a current of either direction could be sent over B with a ground return, thus providing for two other selective signals. So far the combinations are identical with those of Hibbard. A current may also be sent in either direction over the metallic circuit formed by A and B, thus providing for two other signals; and lastly by using A and B, in multiple, currents could be sent in either direc-

tion, using a ground return, thus affording means for two more signals, or eight in all. Two other combinations might be obtained by sending currents in either direction over wire A, and using wire B and the ground in multiple, as a return; and similarly two others by using B for one side of the circuit with the wire A and ground in multiple for a return. These latter combinations, however, have been found to introduce undesirable features, as will be understood later on. The eight desirable current combinations may be tabulated as follows :

CURRENT COMBINATIONS.

	Line A.	Line B.	Ground.
1.....	+	o	—
2.....	—	o	+
3.....	o	+	—
4.....	o	—	+
5.....	+	—	o
6	—	+	o
7.....	+	+	—
8.....	—	—	+

In this table the plus or minus signs indicate which pole of the calling battery at central is connected to either line wire or ground. Thus, in the first combination, the positive pole is connected with line A, the negative, with the ground in order to utilize the earth return. Line B in this combination is not used at all.

Fig. 6 shows diagrammatically such an arrangement of apparatus at eight stations that the call bell D at each station will be actuated only when the one particular set of current combinations is sent over the line. A and B represent two line wires extending from a central station C to a number of substations S^1, S^2, S^3, etc. At each of the substations are two relays R and R^2 placed in earth branches *m* and *q*, from the two line wires A and B respectively. These two branches are united at *e* and connected with the ground at G. The signal bell D is connected with the local battery *s* in a circuit, the continuity of which is controlled by each of the relays R and R^2. Unless the armatures 13 of both relays rest against their back stops 12, the local circuit containing the bell will be opened at one or two points. The relays of each station differ in some way, either in construction or arrangement, from those of all other stations. Thus at station S the main conductor A is branched through a polarized relay made responsive to positive currents from the central office, and the main conductor B through a neutral relay R^2 adapted to respond to currents of either direction from the central office. It is thus obvious that if a positive current is sent over line A without sending any current whatever over conductor B, the bell at station S will be operated because the positive current will cause the relay R to release its armature, while the armature of relay R^2 is already released. Thus, both contacts 10 and 11 will be closed and the bell circuit complete. Station S^2 also has a neutral relay on wire B, and a negatively polarized relay on wire A. The third and fourth stations, S^3 and S^4, each have a neutral relay on wire A and a positively or negatively polarized relay on wire B. The fifth station S^5 has two polarized relays, one adapted to respond to positive currents and attached to wire A, and the other to negative currents and attached to wire B. The sixth station S^6 also has oppositely polarized relays, but their connection with the line is the reverse of that in station S^5. The seventh station S^7 has two positive relays and the eighth station S^8 two negative relays, one in each case being bridged between each limb of the line and ground.

Reference to the table of current combinations will show, in connection with

Fig. 6, that the sending of any particular combination to line will operate the relays of the station bearing the corresponding number in such manner as to close the local circuit at that station. Further consideration will also show that no combination will so operate the relays at more than one station.

At the central station B' is a generator of calling current, and G' an earth connection complementary to the earth connections G at the substations. K is a group of signaling keys, each corresponding with one substation appliance, and when any particular key is pressed it sends the proper current combination to line so that the relays at the particular substation represented by it will coöperrate to close the local circuit and give the signal there; but at the other stations no such effect will take place. Hence, to give a signal at any desired substation, it is only necessary to operate the particular key representing such station. To accomplish this, branch terminals are brought from the line conductors A and B, from the ground connection G', and from the positive and negative poles of the battery to the various terminals on the signaling keys. The arrangement of the terminal contacts in each key is different, the differences corresponding with those of the substation relay arrangement.

To illustrate: In key No. 1 the contacts are so disposed that its operation will connect conductor A with the positive pole of the battery B' at contacts *v* and *y*, the minus pole of the generator with the earth terminal-contacts *z* and *w*, and will leave conductor B disconnected. By this means a positive current is sent over line A and is distributed through all the A relays at all of the substations in parallel, finding return through the earth branches; but as no current is transmitted over line conductor B, all of the eight B relays will remain unaffected. Under these conditions relay R at station S will close

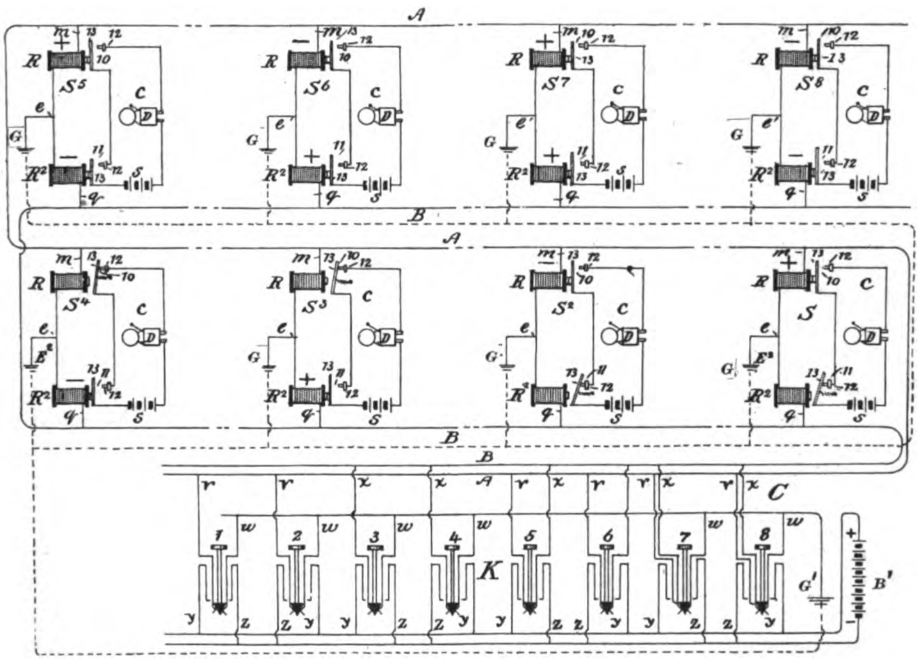

Fig. 6.

point 10 of its local circuit, and the point 11 being already closed by the armature of relay R^2, the normal position of which has not been changed, the local circuit *c* of station S will be closed and the bell at this station will be rung. Station S^2 will not be signaled, because plus currents have no effect on its polar relay R. Station S^3 is not signaled, because the effect of the plus current on main A is to attract the armature of neutral relay R, and thus open the local circuit, which is already open at point 11. Station S^4 receives no signal for the same reason. Station S^5 is not signaled because, though the positively polarized relay on A closes the open point 10 of its local circuit, the said circuit remains open at 11, there being no current on B; station S^6, because neither relay is acted upon, R being of minus polarity and R^2 having no current; station S^7, because R alone is operated, and station S^8, because both relays are of minus polarity.

In applying the principles already pointed out to a practical multiple-station circuit, it is desirable to reserve two of the current combinations for the operation of locking devices common to all stations.

The seventh and eighth combinations in the foregoing table have been found most convenient for this purpose. The seventh, that is, the positive current over both conductors A and B in parallel is used for locking the telephone apparatus at all stations and a negative current over both lines for unlocking the apparatus. Six combinations are thus left for signaling.

The locking device and a visual busy signal are shown in association with complete telephone equipments at two stations in Fig. 7. In these an additional electro-magnetic apparatus R^3 is shown in circuit with the relays R and R^2 at each substation, half of its winding being in the earth branch *m* of the relay R and half in the branch *q* of the relay R^2.

Two electro-magnetic helices *a* and *b* have the ends of their cores joined by soft iron yoke pieces to form the instrument R^3. Two soft iron polar extensions *h* and *f* project inwardly from the yoke pieces as shown. A polarized bar armature *j*, pivoted at j^2, has one of its poles projecting between the pole pieces *h* and *f*, and adapted to move to one side or the other under the influences of said pole pieces. If current is passed through coil *a* only, the magnetic polarity developed will be short-circuited through the yoke pieces and the core of coil *b*, so that very little strength will be manifested in the pole pieces *h* and *f*; if current be applied to the coil *b* only, the magnetic polarity will be similarly short-circuited, and, again, little effect will be manifested in the pole pieces. Again, if current be applied to both coils *a* and *b* so as to act in a complementary direction, the yoke pieces will satisfy the magnetic flux with very little polarity in *h* and *f*; but if current be applied to coils *a* and *b* in inductively opposed direction, as will be the case when the seventh and eighth combinations are transmitted, consequent poles of full strength and opposite polarity will be formed at *h* and *f*. The polarized lever *j* is, therefore, actuated by the seventh and eighth current combinations and remains unaffected by all others.

As shown at the right of Fig. 7, the lever *j* serves not only as a lockout device, but also as a busy signal. The apparatus is shown in its locked or busy position at station S^2 of this figure and in its unlocked or free position in station S^3. When the lower portion of the lever is moved to the left it forms a stop to lug j^3 on the hook-switch *z*, and thus prevents the latter from rising should the receiver be removed from the hook. At

the same time the small target B on the other end of the lever is displayed through a hole in the box, thus showing the party at that station that the line is busy. When in its other position, the busy signal is not displayed and the hook-switch is free to rise.

When the operator at central presses the locking key, say key No. 7, all of the locking levers on the line, including that of the party to be called, will be actuated. In order that the party being called may not be thus locked out, the windings 27 and 28 are provided around the polar extensions *h* and *f* on each instrument. This winding has no function except at the station being called. In that station part of the current from the local circuit, which is closed only at that station by the action of the relays, finds path through this winding, and the magnetism so developed serves to unlock the mechanism and to allow the party at that station to use his instrument.

In Fig. 8 is shown a six-party line, the equipment at each station being of a similar character to that shown in Fig. 7, but simplified for the purpose of clearer illustration. The two sides of the line terminate in the line springs of a spring jack J, which springs normally rest on anvils connected to the windings 31 and 32 of a differentially wound switchboard drop. These two windings pass around the core of the drop magnet in opposite directions, after which they unite at the

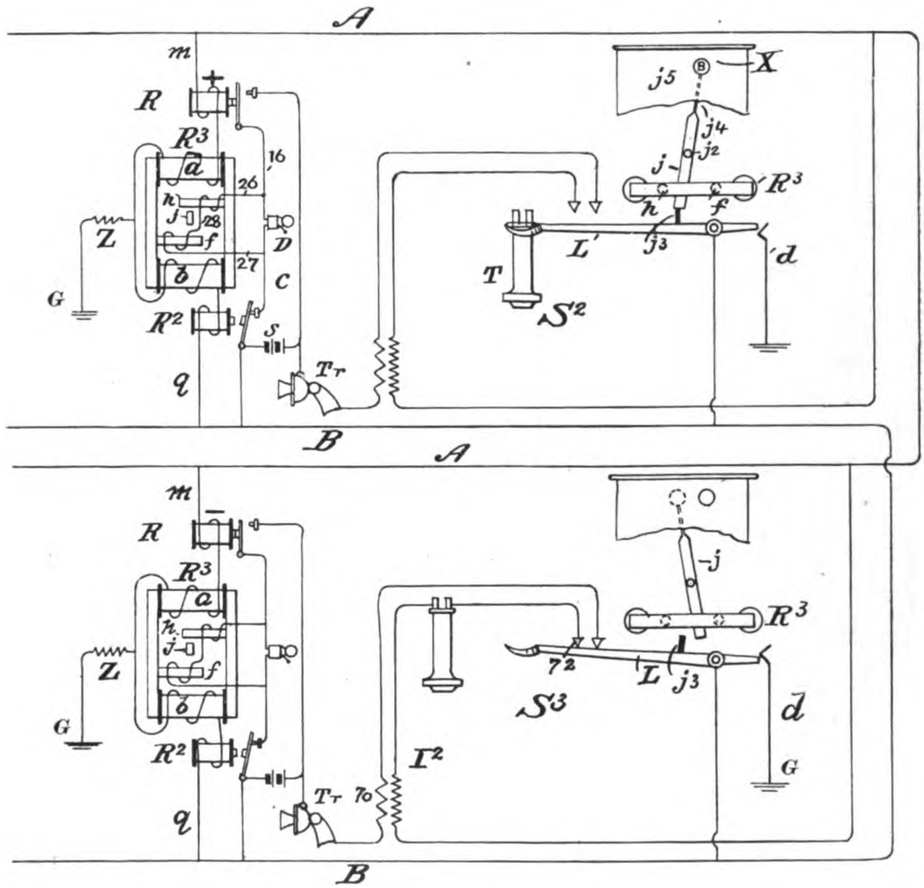

FIG. 7.

point 60 and pass to ground through a battery B^2. The relative direction of the windings on the drop is such that the current from this battery circulates around the core in opposite directions, and thus does not affect the drop. It then divides equally between the two main conductors A and B, and finally returns by the ground connections G at each of the several stations. The current thus flowing to the two conductors from operator. The operator answers the call in the ordinary way by the insertion of one of the plugs P with which the ringing keys *l* in Fig. 6 are associated.

When a substation is to be signaled, the calling plug P is inserted into the socket in the spring jack, which cuts off the annunciator and connects the keys K with that particular circuit. Key l^7, which sends the plus current over both mains in parallel, is then operated to

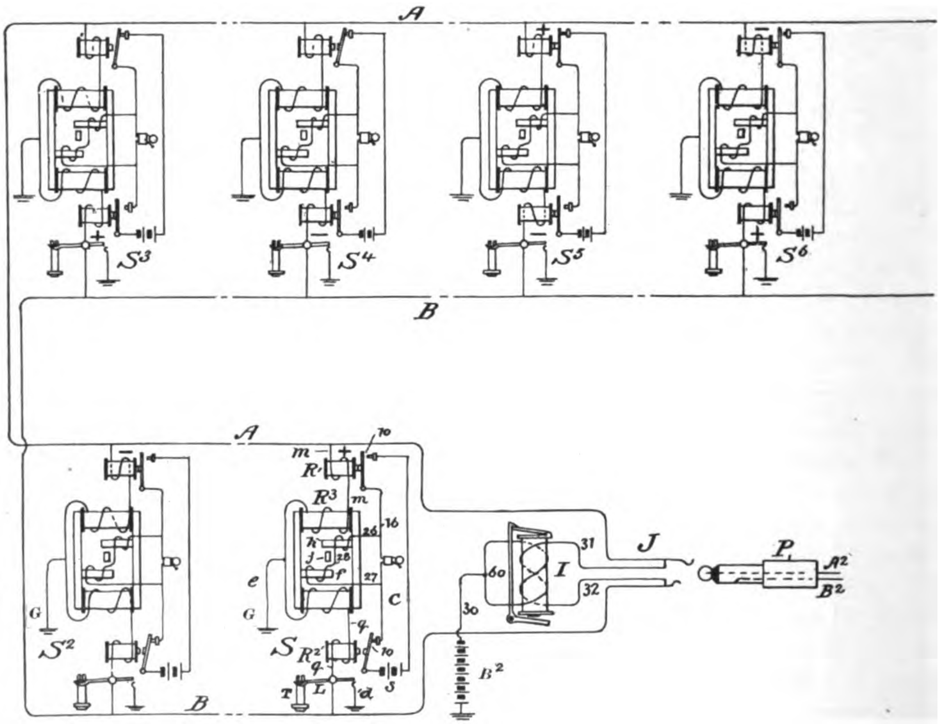

FIG. 8.

the battery B^2 is in a negative direction, and thus tends to maintain the apparatus at the several stations in its unlocked condition.

When any subscriber removes his receiver from the hook, the short arm of the hook lever L makes contact momentarily with the spring *d* which grounds the main line wire B, and thus allows a heavy current to pass through the winding 32 of the drop I. This throws the drop, and attracts the attention of the lock the apparatus at all stations without ringing any of the bells; and then the key representing the desired station is pressed, which results in ringing the bell and at the same time in releasing the telephone apparatus at that station by the means already described. At the close of any conversation, the key l^8, sending a negative current over both mains in parallel, is operated to release the apparatus at all stations, restoring the circuit to its normal condition.

FUEL AND FURNACES.

BY C. E. LAKE, E.E.

It has been shown that the coal supply of the earth, now discovered and available, will support the present enormous rate of consumption for about 54,000 years to come. In burning 198,000,000 tons of coal last year, this country was merely sampling its stock of stored sun heat. The average price at the pit mouth for 1897 (including the relatively high-priced anthracite) was a little less than $1 per ton, which was lower than the price of any previous year. This low figure is all the more significant and prophetic of further reductions, when it is remembered that a strike of coal miners, covering nearly the whole bituminous field, and stubbornly contested, produced a temporary scarcity of coal, which forced a large increase of price during almost half of that year. When there is so much fuel in store, when the price is low, and going lower, when West Virginia coal reaches the Ohio river at 30 cents a ton, the necessity for so much distress about economical combustion, dynamo efficiency, and line loss does not at once appear.

There are, however, large tracts of the United States where the costs of carriage, independent of the cost of mining, make the price of coal so high that some study of economy in its use is not only justified, but demanded. No doubt, the largest saving could be most directly effected in the cost of carriage. Since it is more scientific to freight the finished product than to freight the raw materials, all manufacturing, in which coal is a considerable part of the raw material, should be done near a coal mine. However desirable it may be from an economic standpoint, it will not be possible to overcome to any large extent the inertia of established enterprise and move Massachusetts out to southern Illinois, even when the inducement is a difference of three or four hundred per cent in the cost of coal. Therefore, there will always be a legitimate field for all the means which may be devised for reducing the waste, which ordinarily takes place in transforming heat into motion.

Practically there are three general directions in which it will be possible for the steam user to increase economy. Economy in the character and amount of labor employed in the boiler and engine room; economy in the selection of the proper grade and brand of coal, and lastly, economy in furnace, boiler and engine. Often the mechanical engineer neglects the first two items, where waste is most easily checked, in order to expend a wealth of hysteria over "fancy" furnaces, "fancy" boilers, and valve motions.

Economy in the character and amount of labor employed should be considered first, because labor will often be found the largest item in the cost of power, and because some change can be made along that line without delay or increase of capitalization.

It is no great hyperbole to say that one industrious, hard-working fireman can shovel twice as much coal as another under the same boiler with the same engine load. Real firemen seem to be like real poets, *nascitur*, *non fit*. A knowledge of the theory of combustion would seem to be as essential to the successful stoker as the knowledge of Ohm's law is to the successful wireman. If the stoker really comprehends what combustion is, he will not persist in some of the crochety ideas for which he has become proverbial, and which are handed down from generation to generation of stokers, at the cost of I know not how many tons of coal or how many boiler sheets.

The combustion of coal is simply an active chemical combination — carbon

and hydrogen in the coal with the oxygen of air.

Bituminous coal contains, besides the carbon and hydrogen, small quantities of sulphur, oxygen and other elements which constitute the ash, but the first two are the really important constituents. At ordinary temperatures, the atoms of carbon and hydrogen nestle peacefully in their black chunk, retaining, perhaps, a memory of the carboniferous age, a last kiss in the form of a fern finely traced, or the shell of some queer reptile. Let the temperature rise up past the hot summer mark to 212 degrees, and discontent begins to pervade our quiet atoms. Some neighboring atoms of oxygen and hydrogen, already combined as water, pack up and move off as steam. The restlessness increases with the rising heat till it becomes a rampage at six or seven hundred degrees. Each two atoms of hydrogen throw off old associations and go hunting for a disengaged atom of oxygen, while each atom of the polygamous carbon chases two atoms of the ever popular oxygen. The shock and commotion of atoms rushing together produce the vibratory manifestation we call heat.

One atom of carbon with two atoms of oxygen forms carbon dioxide, or carbonic acid gas. Two atoms of hydrogen with one atom of oxygen forms water, which passes off with the carbon dioxide as steam. Since chemical unions are fixed and definite it follows that a given weight of oxygen must be supplied for the complete combustion of a given weight of carbon and hydrogen in coal. Naturally, then, complete combustion will require the proper quantity and distribution of air and the maintenance of a requisite furnace temperature, all of which is not so very easy to accomplish. If there is not enough air there will not be enough oxygen to "go around." Some of the atoms of carbon will have to get along with only one atom of oxygen, and will go up the chimney as carbon monoxide (CO) producing only about one-half as much heat as would be developed if the other atom of oxygen was on hand. Some of the volatile carbon and hydrogen in this case will pass off entirely unconsumed, appearing as black smoke and soot. Too much air, on the other hand, dissipates the energy of the fuel in "heating up all outdoors," and generally cools the fire below the point at which perfect combustion can take place. This means more carbon monoxide and soot. It is really a sadder waste than the failure to provide enough boiler surface, which sends a good hot fire up the smokestack to overheat the Pleiades.

Avoiding the waste of too much or too little air or too cold a furnace, temperature too high will often, particularly with Western coal, melt some of the ash constituents, and cause glass icicles to run through the grates. Then follows a season of cleaning out with consequent waste and worry in many various ways.

The rudimentary principles of combustion have been outlined, and the chief difficulties in the way of securing perfect combustion have been pointed out. If the man who pays for the coal will take the trouble to understand these difficulties, he will be likely to realize that not every man who can handle a shovel is fit to throw coal under a boiler. It does not follow that no man can fire economically, and that no man can manage a steam plant successfully without comprehending the theory of combustion, but the burden of proof is on both.

Therefore, we first of all examine the stokers in our boiler room to see whether they are competent in theory as well as in fact.

THE DRAKE SELECTOR SYSTEM.

BY THOMAS C. DRAKE.

In all the branches of telephone work, probably the party-line problem has received the greatest share of ingenious applications from inventors and designers of telephonic apparatus. Ever since the advent of the telephone, the problem of connecting many stations to one circuit has been studied, and hundreds of inventors have worked out systems and devices for the purpose.

Up to the present time, it may be said, there has been but one system devised which would admit of connecting up twelve, fifteen or more stations to one circuit, and be operative to any degree. This system is the "bridging bell system" now in common use. This system, as is well known, has one objectionable feature, which is of a serious nature when working so many 'phones on one circuit, and from the very nature of the system cannot be eliminated, namely, that all bells across the circuit ring simultaneously when operating the line to call a station, and consequently involves in its operation a code of signals consisting of a combination of rings which enables the various parties to distinguish their calls from those of others, and these are confused by the parties to the detriment of the service.

It has long been recognized that if a system of individual or selective signaling could be devised which would enable any station on a party line to be picked out or selectively rung to the exclusion of all others on the same line, that it would undoubtedly constitute an ideal toll line and small exchange system, if not a party line that could be advantageously employed to some extent in large exchanges, and to this end inventors have proposed all conceivable combinations of electrical and mechanical contrivances in endeavoring to perfect a system and solve the problem.

Of the many methods involved in this unperfected work, probably the most promising is some form of step-by-step mechanism to pick out or select the desired station, as, with a system of this nature, the number of stations that could be operated on one circuit would be limited for other reasons than the selective capacity of the mechanism, and a step-by-step system would, therefore, have a wider range of application than those systems which are limited to four, six, or probably eight, to one circuit.

The use of step-by-step mechanism for selective signaling has from the very first offered the most plausible solution of the problem, and there are seemingly no insurmountable obstacles in the way of designing and perfecting a thoroughly practical device and system of this character. But from the hundreds of patents issued for systems and apparatus of a selective step-by-step nature, it yet remains for a commercial system to be brought to the attention of the public. To work out a system not containing some method or details embodied in the numerous patents already issued would be an impossibility, as the ground has been so well covered. In fact when one looks into this phase of telephony he wonders what other combination could possibly be constructed for the same purpose.

The writer has given this phase of telephony considerable thought and attention and constructed some actual working systems, and has in operation at the present time the largest selective step-by-step party line ever placed in operation so far as there is any record. Every detail entering into the step-by-step problem has been studied, and it is believed that if a practicable system can be brought about, it can be done through the mechanism employed in this system or a modification of the same.

The writer has confidence in the success, soon or later, of a practicable selective step-by-step system for all party-line schemes, such as small isolated automatic exchanges not exceeding fifty 'phones on one circuit; toll lines in general, or those of reasonable length, probably not exceeding fifty miles; a party-

line scheme for a certain class of service in large exchanges, a scheme operating ten stations, or more if desired, on two wires and a common return or on a metallic circuit by the use of condensers, and operating in a more satisfactory and practicable manner than any system yet devised; a system with lockouts and busy-line indicating devices, and everything necessary to make a desirable and satisfactory arrangement. There is no question about the utility of such a scheme if the mechanism can be brought to a point of perfection, and it is believed it has been or can be done.

It is the purpose of this article to describe the selective system worked out by the writer and employed in the operation of a party line which is undoubtedly the largest experiment ever undertaken with step-by-step mechanism or any other method of selecting, it having at the present time fifty-three telephones connected to one circuit and is being operated as an automatic isolated exchange. Probably a system operating so many 'phones as this should not be termed a "party line," but really it is nothing more, as all telephones are connected to a line, common to them all.

The same mechanism has recently been placed on a ground-return toll-line circuit fourteen miles long with a view of determining what, if anything, would be required in addition to the apparatus installed to bring about a practicable system for the operation of toll lines on a selective plan. Twelve stations are connected to this line and the bells at but one can be rung at a time. So far this system has come fully up to expectations, if not more. It has demonstrated the practicability of a selective scheme to lines of considerable length, and further, that the number of stations possible to be connected and operated on one line is limited only by the capacity of one wire to accommodate the traffic.

A full description of this system will no doubt be of interest, in view of the fact that it is the general supposition that a step-by-step system has yet to be reduced to practice. As this system has been in practicable and satisfactory operation since January, 1897, ample time is thought to have been given it to show up any and all troublesome and impracticable features and an opportunity to study and remedy the same.

The most interesting part of this system will of course be the mechanism and the method of operating the same. It will therefore be fully described in this article, while in the next issue of this journal will be taken up the complete apparatus as employed in the operation of small isolated automatic exchanges, and will be of interest chiefly because it appears to be the most practicable system yet devised. It will work thirty-five telephones on one circuit in such a manner that any station can call any other station without ringing any but the one bell at the station desired, and operates without a central office and operator.

In the same or a subsequent article will be described a special party-line apparatus just completed and ready for a practicable demonstration of its utility. It is intended for toll lines or communities where but a few subscribers exist. The apparatus operates from a central office only, and has a capacity of thirty-four stations on two wires. The stations call central by means of a push button which closes a circuit, and central calls stations by operating the step-by-step mechanism which closes the ringer circuits. A description of a ten-station selective, step-by-step, party-line system, with all modern necessities, is being worked out for a certain class of service found in all large exchanges, and a description of the same will be given in this journal as soon as perfected and in successful operation.

Many inventors in this line have undertaken to combine a step-by-step system and telephone devices in such a manner as to operate on a single circuit, but this method is thought to be impracticable owing to the inductive resistance of the magnet coils which must be permanently in the circuit.

The better way, it is believed, is to provide two circuits — one for the telephones and another for controlling the selective mechanisms. More encouragement has apparently been gotten by experimenters, generally, and a more nearly practicable system devised on this method than the other, although the

single circuit is the ideal way to work a system if it could be done. The system to be described required two lines or circuits which are in no way connected with each other. Over one is operated the selective step-by-step devices in series, and on the other is connected the telephones in open multiple.

Referring now to Figs. 1 and 2, the construction of the step-by-step mechanism may be understood. M represents the electro-magnets which are placed in series in the line circuit. The armature A is mounted on an angle lever L which

s' forms the other. A retractile spring T of piano wire leads from the insulated screw C' to an adjustment T' through an insulated block *i'*, which is also mounted on the arbor *d'*. This retractile spring also forms a conductor when closing a circuit between the contact screw C' and the contact disk C. The contact disk consists of a brass disk, around the periphery of which is vulcanized a rim of hard rubber. A segment *c* of German silver is securely set in the brass, and forms a conducting segment when the hard rubber is finished off.

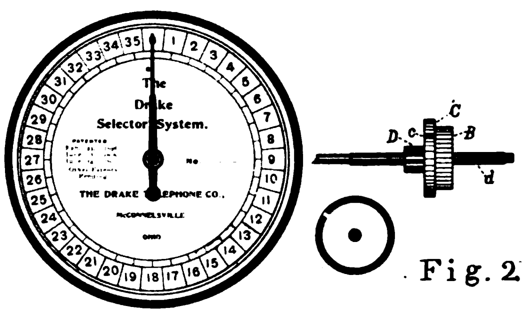

Fig. 2.

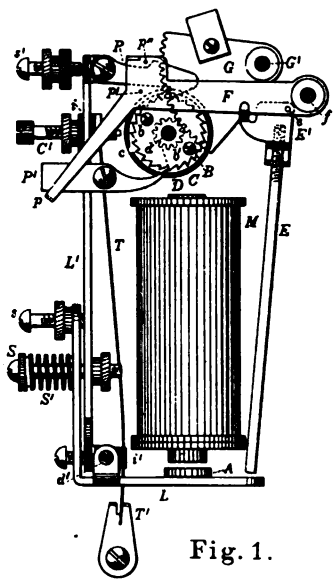

Fig. 1.

is hinged on a pivoted arbor *d'*. This arbor also carries a lever L', the upper end of which carries two pawls P and P'. These pawls act by gravity to engage the ratchet wheel. B is the ratchet wheel, C is a contact disk, and D is a pinion gear, all of which are mounted on a shaft *d* in such a manner as to allow the free and easy adjustment of the contact disk by loosening the set screws *b* and *b'*. The contact disk is mounted between the ratchet wheel and pinion gear, which are pinned to the shaft. On the shaft is also carried a hand or pointer for indicating at the stations the position of the ratchet wheel and contact disk, as well as that the "line is busy" when the system is in use. This hand and dial, as shown in Fig. 2, are external to the case containing the mechanism shown in Fig. 1. The ratchet wheel is stepped around by the pawls in an obvious manner when oscillating the levers L' and L. A contact screw C', with a platinum point, is carried by and insulated from the lever L' by an insulating bushing *i*. This screw also forms one of the adjusting screws for adjusting the pawls to the ratchet wheel, while screw

It will be observed that this method of making contact or closing a circuit at a predetermined position of rotation of the contact disk with the screw C' is perfectly frictionless, owing to the fact that the lever L' carrying the screw C' reciprocates to the face of the disk, and for this reason no rubbing of contacts or surfaces is possible; therefore all friction is avoided. These contacts are in the ringer circuits for the purpose of closing the same, and before trouble could occur their resistance would have to go higher than the capacity of the magneto-generator to ring through resistance. A case of trouble of this nature has never yet occurred. A frictionless contact arrangement is an important factor in the con-

struction of a step-by-step mechanism, and it is believed that this point has been the cause of more failures than any other. Returning now to Fig. 1, F represents a bifurcated lever mounted on an arbor *f*, and is adapted to disengage the two pawls P and P′ from the teeth of the ratchet wheel. Two pins *p′* and *p″* of soft copper wire are adapted to be bent into position in adjusting the mechanism, *p′* lifts the pawl P, and *p″* checks the momentum of the ratchet wheel so that but one tooth will be passed over at any one step. The long arm of lever F has its tip *p* bent to a right angle in order to throw the pawl P′ out of engagement with the ratchet wheel at the same time the pin *p′* disengages the pawl P. A lifting rod E, threaded at its upper end, screws into an adjustment E′, which is constructed to bind the threads when once the proper adjustment has been secured. The adjustment E′ is hinged to the lever F at a point *e*. G represents a weighted segment gear which is wound up by stepping the ratchet wheel, and is adapted to give a retrograde motion to the same on disengaging the pawls, consequently restoring the contact disk and hand to normal position. By observing the dial in Fig. 2 it will be noticed that a pin for stopping the hand at naught has been provided. This is the normal position of the mechanism when not in use. S and *s* are screws for adjusting the magnetic action of the mechanism, S controlling the stress of helical spring S′. A battery current of two strengths is necessary in operating this mechanism. We will designate them "heavy" and "light" currents for the present in order to make the operation of the mechanism clear.

The heavy current operates the mechanism in such a manner as to disengage the pawls from the teeth of the ratchet wheel, thus allowing the weighted segment gear G to restore the contact disk and hand to normal position, while the light current operates the mechanism in such a manner as to step the ratchet one step each time the current is pulsated through the electro-magnets. This mechanism has been termed, by patent office nomenclature, a "step-by-step and restoring" device.

In adjusting the mechanism the armature A is allowed to kiss the poles of the magnets on passing the heavy current, the construction being such that no sticking of the armature is perceptible. This is done on account of the liability of heavier current than the mechanism was made to stand being accidentally passed through the coils, which, in that case, would strain or bend the levers by the great attraction of the armature, and therefore throw the mechanism out of adjustment. The lifting rod E, by means of the threads, is given such an adjustment as to lift the lever F high enough to disengage the pawls when the armature has been attracted to the cores of the magnets by the heavy current. The stress spring S′, it will be observed, holds the two levers L and L′ together, and before the armature can be fully attracted to the magnets the stress of this spring must be overcome. The stress of this spring by means of adjusting screw S is made such that the heavy current will overcome it, but the light current will not.

The light current is next pulsated through the coils, and a relation secured between the magnetic action and the retractile spring T by means of the adjustment T′ and the screw *s* which will reciprocate the levers and thereby step the ratchet wheel in synchronism with the pulsating current.

It is doubtful if a step-by-step mechanism has ever been constructed that would admit of such rapid operation as this. It is possible to step the rachet wheel thirty-five numbers in four seconds, and in the common operation of the mechanism by the subscribers to a system it has been found to require, on an average, about eight seconds for the same number of steps. This is equivalent to saying that with thirty-five 'phones in a system any party could ring the largest number on the dial in less than eight seconds, or could ring the lower numbers in a proportionally shorter time.

In Fig. 2 a dial having a capacity of thirty-five numbers is shown. As "naught" takes one tooth, a ratchet wheel with thirty-six teeth is required. Selectors of no other capacity have as yet been designed.

A novel method of securing the heavy and light currents necessary for this mechanism when being operated as an automatic exchange, is thought to be here employed for the first time. Many step-by-step devices have been devised which operated by means of currents of different strengths, but this variation has been controlled by devices centrally located, and either manually or automatically operated. Very few step-by-step systems have ever been intended to operate in any other way than from a central office, and therefore schemes to make a system operative from as many points as there are stations have never been worked out to a practical method.

The method employed for this system is substantially as follows: Resistance coils of approximately one-half the resistance of all the selector magnet coils in series, and the connecting line circuit, are placed at each mechanism or station. Switches are provided for throwing these resistances into the selector circuit, and in this way the normal, or heavy, current is diminished to the light current according to the known laws.

Referring now to Fig. 3, we will suppose that four stations are connected as shown; 3 and 4 represent the two sides of a metallic circuit line, and 1 represents a series line in which are connected the selector coils and battery I. The two lines have no connection in any way with each other. For simplicity of explanation, no other telephone apparatus than a ringer has been shown in this figure. It will be observed that the ringers K are in series with the selector C and C′, and that both are in multiple with the two sides of the line 3 and 4.

It has not been definitely stated in this description, so far, that the series of step-by-step devices operate in synchronism, and are supposed to be in unison at all times with respect to "stepping" and "restoring," but it is obvious from the description, and of course is presumed that the reader already understands it in that light. Simply stated, it would be this: As one selector does they all do, and if the hand at one station indicated 25 the hands at all stations will indicate the same.

The contact disks, as already explained, are adjustable, and are set at a different position at each station, therefore but one ringer circuit can be closed at a time. The number at which a selector is set to close the ringer circuit is always marked on the dial, as No. 25, etc. In this respect the idea of closing a ringer or bell circuit in multiple with a line differs in no way from several other systems.

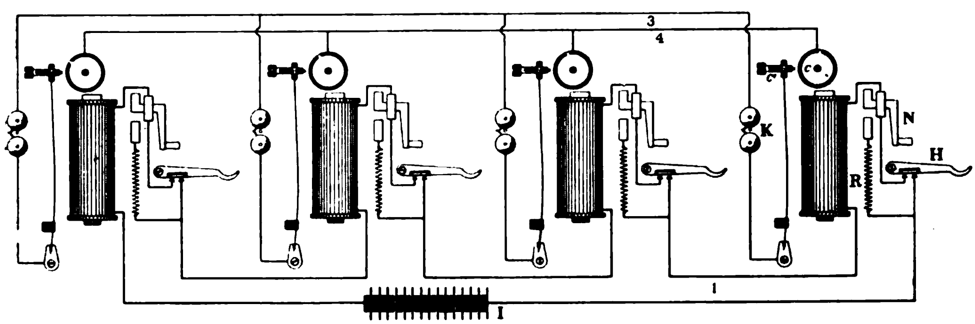

FIG. 3.

We will now return to the series circuit and the method of operating the selector devices. At each station a contact crank N is provided for pulsating the current by making and breaking the circuit *l*. A resistance R is also provided for diminishing the strength of the current. A switch H short-circuits the contact crank and resistance when in its "down" or normal position. The battery I is of sufficient strength to give the heavy current when the resistances are all cut out.

It was thought best to wind the selector coils in this system to a resistance of

35 ohms. This was on account of the switch and crank contacts having to break the current so often that they would soon burn off to such an extent that new ones would have to be substituted if much current was to be broken. This resistance has been found very practicable for all purposes, even for working long lines.

We will now deal with the practical operation of a system with reference to Fig. 3. A rule has been established by which three cells of open circuit battery, giving a potential of 4.5 volts, are to be connected up for every selector in the circuit. A like amount of battery is also connected up for every 35 ohms of resistance in the circuit other than the selector coils, this amount of battery being necessary to give the heavy current. Suppose a system of 35 selectors is to be operated on a line which has a resistance of 175 ohms. The resistance of the whole circuit would then equal 40 selectors or 1,400 ohms. This would require a battery of 120 cells, giving a potential of 180 volts, or a current of .12+ amperes. This would constitute the heavy current which would disengage the pawls by giving such a magnetic pull to the armature A as to overcome the stress of spring S′.

The resistance R in this case would be one-half the resistance of the entire circuit, or 700 ohms. If, now, the mechanism is to be stepped to call a station it become necessary to cut in one of the resistances R which is done by breaking the short-circuit with a switch. On revolving the contact crank N the resistance of the whole circuit will then be 1,400 + 700 = 2,100 ohms, and the current's strength will have been diminished to .085+ of an ampere, which would constitute the light current, necessary to step the ratchet wheel, contact disk and hand in a manner that has already been explained.

So far, an open circuit battery has been described in connection with a closed-circuit system, which is obvious from Fig. 3. It is well to state in this connection that a very ingenious and practicable device has recently been worked out by means of which it is now possible to operate this system on an open-circuit plan, therefore adapting the open-circuit cell. This device will also be fully described in the next article.

When a system of this kind was first installed, thirty-five instruments were connected and a battery of 150 cells of the Crowfoot gravity type was employed to operate the selector line. It was not long, however, until it was apparent that unless some form of battery giving a constant potential for a considerable length of time could be applied to this system it was impracticable for operating an isolated telephone exchange automatically, as some attention would be necessary each day in adjusting the battery. The open-circuit cell possessed all that was required if kept on open circuit almost continuously, and it has demonstrated its adaptability to the case, and at the same time lent a helping hand commercially, as the expense of maintenance was $10 as against $150 with the gravity cells.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION.

Some thirty exchanges from this State were represented at a preliminary meeting held at Columbia, Missouri, last month, at which the Missouri Independent Telephone Association was organized. J. A. Hudson, of Columbia, was chosen as temporary chairman, and E. W. Henry, of Glasgow, temporary secretary. A committee was appointed to form a constitution and by-laws, and will report at the next meeting, to be held in St. Louis on December 27.

WHAT THE LAW DECIDES.

The doctrine that the placing of electric wires known to be dangerous at a place where others are lawfully entitled to be constitutes negligence is applied, in Perham *vs.* Portland General Elec. Co. (Ore.), 40 L. R. A. 799, to wires strung over a bridge where workmen in repairing the bridge come in contact with them; and it is also held that the apparent perfect insulation of the wires amounted to an invitation to risk contact with them, when the wires are placed where persons in performing their duties may come in contact with them.

THE INSPECTOR AND THE TROUBLE MAN.

II.—BY THE INSPECTOR.

WILL MAKES A BLUNDER.

"Say," said Will, coming in two or three days afterward, "there was a trouble this morning on 411 I could not find. The man's bell would not ring, and I took down some sal ammoniac and renewed the battery, but it didn't seem to make any difference, though I could call Central, and talk all right."

"Well, you are a peach," said George, sarcastically, "How in the —— —— —— did you ever come to think of fixing up the battery to make the bell ring? Well, you're a good one."

"Why, that is what I saw you do one day," stammered Will, "for when 216 was open you went down and found a loose connection in the battery, and it worked all right when you fixed that; besides, what is the battery for if not to ring the bells?"

"Well, now," said George, thus thrown on the defensive, "I give you credit for observing that, and, of course, you have not been here long enough to know everything; but that case was different from the most of them. The instrument was not properly wired in the first place, so that the line wire comes through the battery, and, of course, an open battery would produce an open line.

"When this exchange was built, the manager lacked experience, and wanting to see which instrument was the best, he bought a few of each kind; besides, if a smooth agent came along and offered him an instrument cheaper than anybody else, he would buy it without looking at it. There are a lot of those in the back room now, and when they are fitted up with new receivers, new transmitters, new induction coils, new switches, new magnetos and new ringers, they will be very good instruments. Of course, there is such a thing as making unnecessary expense in some parts.

"Now, you need not say anything about this to the subscribers, for when outside this office you want to keep a stiff upper lip, and never let on but that the instruments we have are the best in the world. It is sometimes hard, though, to have to take the blame for all the trouble from subscribers and managers alike, and troubles for which, the lineman knows, the only cure is a vigorously wielded axe.

"Well, we must put up with it till instruments get standardized, and managers have learned their lesson." George always became impatient when talking on this subject. But meanwhile Will had not lost sight of his first question, and now wished to know what the battery was for?

"See here," said George going to an instrument and opening it, "Just begin with that battery wire and trace it out."

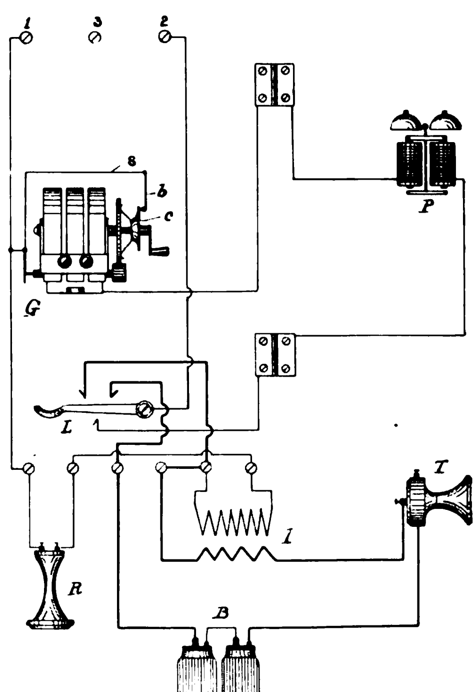

DIAGRAM AS EXPLAINED BY GEORGE.

"Here is the first one ending at one of the switch clips."

"Yes, and when the switch is up that

connects it with the other clip. Now trace the wire from the other clip."

Will traced the wire down till he came to the transmitter, when he paused. "Now where does it go?"

WILL BEGINS TO LEARN.

"Here," said George, taking a transmitter apart, "You see this wire comes in and connects with the back plate of the transmitter. Then it goes through this mass of granulated carbon, see? — then through the front disk and connects with that other wire, making a loop through that granulated carbon, and that shaking up of the carbon when you talk against the front disk causes a variation in the battery resistance, and so makes a constant change in the amount of current going through. But to return to our subject: this wire has been traced from the battery to the transmitter. Now, from the transmitter?"

"It goes to this binding post, and then takes two wires."

"Yes, it takes a white and a green one, and both go into the induction coil. Now, in order to find out which is which, we will try another tack, and trace the other wire from the battery. Here it comes, and you will find that it takes the white wire in that same induction coil, so for the present at least we will say that the green wire does not count. Now, did you find any bells in that circuit?"

"No," said Will.

"Well, now, remember that. The battery circuit, then, consists of the upper clips of the switch, the primary coil, the transmitter and nothing more; and remember further that the order in which they are placed does not count, except as a matter of convenience. In case of trouble in a transmitter circuit there are three places where it is most likely to occur: first, in the battery; examine that carefully and see if your connections are all right, as well as the solution; second, the transmitter. There are several causes for transmitter troubles; for example, here we have one mounted on a hinged arm. There is plenty of room for suspecting trouble at the hinge, as the iron contact surface in the hinge is frequently rusted, and rust will act as a cut-out.

"Then, too, there is the transmitter itself, which makes more trouble than all the rest combined, for there are so many chances for trouble there, especially in the cheaply made instruments, that it keeps a man guessing where he is at. Sometimes the carbon disk is merely held down by the cap that covers the front, and this gets corroded enough to make a poor contact. Then in the Hunnings type of transmitter, in which poor carbon is used, sometimes it all gets down in one corner and packs, so that the diaphragm cannot move; this a good shaking-up generally remedies.

"This packing is generally caused by moisture getting in through the carbon diaphragm, and there are several ways of preventing this. One man uses oiled silk or paper in front of the carbon, while others are satisfied with giving it a coat of shellac, still others use a diaphragm of steel or aluminum, while diaphragms of mica, wood, cork, parchment and paper have all had their turn.

"There is in most instruments of this type a fringe of wool, cotton, felt or fur, to hold the granules in place, and it generally does, but sometimes they get out of their places and work down, so as to wedge the diaphragm. Then, too, it sometimes happens that a transmitter comes from the factory with too much or too little granulated carbon in it, in which case the amount must be changed till you get it right. There is one solid-back transmitter made, which was regarded as the best thing out, except that it would cut out; and a most puzzling affair it was, for I never could catch it long enough to locate it. I did finally find out what it was, by taking the thing apart and guessing the rest, and since then I hear that others have had that same trouble with that transmitter.

TRANSMITTER TROUBLES.

"In that case the trouble was caused by the use of too much carbon in the cup, so that if ever it did pack it wedged tight. Take the transmitter off the hook and you would 'get battery' in the receiver, but not a sound could you get through it. That trouble was cured by removing some of the carbon granules. Some agents I have known

make it a point to hold the receiver up against the front of the transmitter mouthpiece, and if the receiver 'sings' it is taken as proof that the transmitter is all right. Now, I just want to remind you that this test only proves that the *receiver* is all right, and that the transmitter circuit is closed, but it does not prove that you have a good transmitter by any means. There is only one way to test a transmitter, and that is to blow softly on the diaphragm or talk into it. In former days they used to adjust their transmitters with a galvanometer until a certain resistance was reached; and while, of course, a transmitter will not remain constant, yet a few minutes' test will strike a good average. In the transmitter spoken of, I understand the manufacturers are more careful now.

"Then I saw a transmitter with a mica diaphragm backed by a small carbon disk in the center, which was connected with the frame by means of a German silver wire, which was stretched across from one side to the other. Of course, service on such a thing as that was very unreliable.

"Last of all comes the switch, and there are some switches that are not worth a continental, being made of cheap brass or German silver, and not heavy enough to make a reliable contact, to say nothing of the fact that they become corroded and can be relied upon to cut out about half the time. Nearly all spring contacts, even when made of platinum, will occasionally make trouble, though there are records of some that have run for years without it. I have known of telephone instruments that had not been touched for two or three years. Yes, I knew of two or three cases where even the battery was not touched for more than two years, and they gave good service up to the last, and generally a broken zinc first called attention to the trouble. No, you can't buy that telephone for $7, and you can't get that kind of a battery for 15 cents, even though it is a sal ammoniac battery.

"How can you tell when the transmitter circuit is open?" broke in Will at this point.

"Why, by listening on it, of course. You take your telephone off the hook and blow upon or tap the transmitter, and if you can get no sound you may know that the trouble is in that circuit, unless your outside circuit should be dead, and you can tell by listening whether you get line induction or not. If you get your line induction, and at the same time your transmitter is dead, you know where to look for it. In order to look for it, take your receiver off the binding posts and connect one terminal to one side of the battery and move the other from point to point along the other leg toward the top until the trouble is located. Thus, if you can hear the battery click up to one side of the transmitter and don't get it on the other side——. See here, you idiot, what are you laughing at? See here, I don't want to tell you this over again, so pay attention. Now, what did I say?"

Will repeated the last part of his instructions.

"Very well, now I guess you'll remember that. I forgot to say that in this test you should wedge the switch down so as to leave the upper clips open, or otherwise the current will come clear around and meet you on the other side.

"Then there may be a short circuit in the transmitter — not exactly a short circuit, either; but suppose the granules get packed or tightly wedged, or a screw from the outside case penetrates too far. In that case the receiver will click good and strong when the hook comes up, but blowing on or tapping the transmitter will either produce no sound, or at the most very little, so that you know that the short circuit is somewhere in the talking apparatus. Sometimes, however, there is also a short circuit beyond the transmitter. In that case it will 'drum up' all right, but will not pass out on the line. Open your line at the binding posts, and if it still drums up you know that there is a short circuit or cross in the instrument, and the only thing to do is to test and follow up your circuits, and especially to see that the down spring on your switch clears when the hook comes up.

"To test your battery, just move your switch hook up and down or blow across the front of your transmitter, and a little practice will enable you to tell whether

the battery is strong enough; but a better way is to use a Warner's battery gauge, which indicates the strength of the battery. If a cell of sal ammoniac battery indicates above 25°, you know it is all right. However, we have only one of those in this office, and I want to keep that myself, because you would probably smash it in a day or two."

It irritated Will, who was nearly twenty-one and convinced of his being a full-grown man, that George should continually treat him as a boy, but he well knew that if he protested that individual would cease to supply further information, and he certainly was anxious to learn.

"Where does that green wire go to that is connected to the induction coil?"

"That," replied George, "is the secondary coil."

"And what is that for?"

GEORGE EXPLAINS THE INDUCTION COIL

"Oh, that is used to send the talk out over the line. You see it is this way. Those currents in the transmitter, when the voice shakes up the carbon, will make the battery current first stronger and then weaker. That is, they keep going up and down like a hammer in a stamp mill. Now, there is one peculiarity about electric currents of that kind, which is, that a current either vibrating or alternating will set up another current in any other wire next to it, so that when we wind two coils together on the same spool, though they are insulated from each other, yet the induction from one will set up a current in the other, and to help this out further we use an iron core, which greatly increases the effect. Now, never mind why it does, just take my word for it, and if you want to find out more about it, buy some books on the subject and read up."

"Why not send the battery right directly to line?"

"Say, how far do you think that battery of two cells would work a telephone over a line of rusty iron wire, including two receivers and a ring-off drop? Of course, we can get along without an induction coil, and in some systems where the lines are short and all copper wire is used, it is often done, and those systems are being largely installed in many cities where they have a large number of subscribers in a small space, but not here. No, the reason we use an induction coil is because we have to get that current over lines having high resistance, and to do this we have to raise the electrical pressure or voltage, and here is another peculiarity in dealing with this kind of a current.

"You see this primary coil (picking up from the table one which had been taken apart) is wound with a very few turns of comparatively coarse wire. This one has about one hundred and fifty turns of No. 22 or No. 24, the resistance of which is, perhaps, one ohm. Outside of this we have from 3,000 to 5,000 turns of No. 34 or No. 36 wire and a resistance which differs, of course, but is generally from 200 to 500 ohms. Of course there are coils wound as high as 1,000 ohms, and some as low as seven ohms, but we have nothing to do with them in this exchange.

"Now, as I said before, the battery variations in this primary coil will only have a current strength of about three volts. What is a volt? Well, a volt is the unit of electrical pressure, and we speak of volts in the same way that an engineer would speak of the steam pressure on his gauge. See? It means a certain intensity or power to overcome resistance. Do you catch on? All right. Now, this pressure of three volts is greatly increased by the number of turns in the secondary coil, and is liable to be 1,000 or 1,500 volts.

"What's that? Well, you must remember you are not dealing with a trolley or electric light current.

"No, it is not; for while the pressure is the same, the current is very small. See here: suppose the firemen were to turn the hose on you, what would be the result?"

"Why, I would be turned a double flip-flop."

"Exactly. Suppose, though, there was a small leak the size of a pin in the hose. Why, you could hold your hand over it and hardly feel it, and yet the pressure from both the nozzle and the pin hole is just the same.

"Now, the trolley and electric light

give currents which bear the same relations to a telephone current that a four-inch stream would to a pin hole. Do you see now? Did you ever draw a spark to your finger from a moving belt? Well, that spark was from 75,000 to 100,000 volts. Now, as I said before, this higher pressure carries the current over a high resistance with very little loss, so that while without the induction coil we might talk over 200 ohms, with it we have no trouble talking over 40,000 ohms or even more — that is, in a laboratory; out of doors the induction cuts it down."

"Do all induction coils have white and green wire?"

"No, they do not — well, in a case of that kind you can use your receiver and battery to test them out. Generally one end has only one wire sticking out, while the other end has three. In that case the single wire generally belongs to the primary coil, and of the three at the other end only one will give a click in the receiver. If, however, they are not arranged in this fashion, go on any one wire and find its mate; and when you have done this then try the 'click' on the other pair. You can tell by the difference in sound which is which, for the primary coil will be the louder of the two. Then take one leg of each pair and test them again to see if the two coils are crossed with each other, and if they are clear, of course you will get no click. You can also test the induction coil the same way at the instrument, by disconnecting both ends, and by that means tell whether it is open or crossed. Nearly all the trouble from induction coils comes from the secondary winding, so always test that first."

"See here," said George, all at once remembering, "did you fix that bell at 411?"

"No; I was waiting for you to tell me how."

WILL'S TROUBLE EXPLAINED.

"Let me see. You say you could ring and talk to Central, but she could not ring back. Now, there can be only one of two things the matter there: either the bell armature has got out of adjustment and become locked in some way, or the two wires running to the bell magnets have become short-circuited with each other.

"First, try the clapper with your finger and see if it moves freely and strikes both bells alike. Now get down there after that, and don't ever again renew the battery because the bells don't ring, or I shall have to class you with that fellow down in Indiana who, having a cross that he could not clear right away, went to the telephone and opened the battery circuit to keep the battery from running down.

"Aren't you gone yet? Here you stand gassing while subscribers are howling for connections. Scoot!"

III.

GEORGE MEETS AN OLD ACQUAINTANCE

"Mr. Wilson," said the manager, "there is a man out in the office looking for work; do you think we could use him for a few days? I think," he continued, "he is rather hard up, and if we can give him some help with benefit to ourselves, we might just as well."

"Yes, I think we can," said George. "I would like to overhaul that No. 2 cable and find out where all that cross-talk comes from, and we can send him and young Butler out pulling up some of these lines and getting ready for winter. Then that Z street lead needs to be pulled up to reduce the trouble account in that direction. Yes, you can easily give him a month's work here with profit to yourself; that is, if he is a good man. Send him around, and we will find out what he knows."

George looked attentively at the newcomer for a moment, then advanced and extended his hand.

"Well, I'll be hanged if this isn't Johnston. How in thunder did you ever come to be out here?"

"Ditto," said Johnston. "The last time I saw you was when you and I were working for opposing companies in Newark, and we were in opposite gangs fighting for right of way on Broad street, and our side won by about five seconds. Well, well, how telephone men do get scattered around."

"Let me see, that was three years ago; where have you been ever since?"

But why go into the details of the conversation that followed; of the places they had worked; of the men they both knew and the country they had seen, for construction men one way or another manage sooner or later to see all parts of this great country.

George put him at work in the shop till dinner time, then took him around and found a boarding house for him, and did all in his power to make him feel at home.

"Now," said George, after dinner, "we have a cable here in which there is a great deal of cross-talk, so bad, in fact, that with one subscriber connected in, you can talk to him over almost any other wire in it. I have been here only about two months myself, and have been so busy with worse troubles that I could not get around to it, but now that I have you here we will tackle it. Here is a testing set, and if you like you can go up that pole and ring in the wires one by one and open them, while I test for leakage. I have never been up to that cable box yet, so I don't know what you may find there."

Johnston did so, and after one or two tests, in both of which the line rung "clear" from the board, he happened to notice something.

"I have found it," he yelled to George. "Just take things easy for a half an hour or so, till I come down."

George could not see what he was doing, except that he took a piece of rubber tape out of his pocket and was industriously working away inside the box. Curious to know what Johnston had found, he went up the pole himself, and found that astute individual busily engaged in rubbing out pencil marks.

"Well, I'll be blanked," said George.

"Same here," said Johnston.

Now what had Johnston found? In order to save the expense of binding post terminals, the ends of the cable conductors had been brought under wood screws and washers in a hardwood strip. In order to keep the screws in line the strip had been heavily marked with a black lead pencil, which, when the wires were screwed down, made a connection between all of them — a high-resistance connection, 'tis true, for the generator could not ring through it, but still low enough to allow the telephonic currents to pass from one end of the strip to the other, and to that extent bringing all the lines together.

When the pencil marks had been rubbed out the cross-talk was gone.

"Now," said George, "we want to get a different kind of a strip there, for that is a poor way to connect cable wires, but I may not be able to convince the old man of that. Now, I will report the cross-talk as coming from that strip and see if I can't persuade him to change it. If we can't do any better we can get some strips of hard fiber with brass clips placed across them, and have the outside connections screwed down and the cable wires soldered to the other end."

"Yes, that would be almost as good as hard rubber strips," said Johnston.

"Well," said George, "we got through with that work in less than an hour, when I expected to take at least a day."

WILL TRIES AN EXPERIMENT.

Just then Will came in with an induction coil in his hand.

"Here is a coil I can't do anything with. I think it must be open. I took it out and went after three or four more troubles and got them all right, and now I want a new one to put back where I got this."

"Well, we don't happen to have any more induction coils on hand just now. Couldn't you fix this? Besides, why did you leave a man's line open while you were chasing after other trouble?"

"I didn't leave it open," said Will, "for I connected the battery and transmitter to the secondary binding posts, and it talked good enough to last till I came back."

"You did!"

"Yes, isn't it all right when I couldn't do any better?"

"Who ever put that idea into your strawberry head?" "Well, I must say," he continued, "that you are a very smart boy. I have known men to hunt trouble for ten years and never think of that. Well, it's all right; here is the trouble in this coil," for George had taken the cover off the induction coil

and found the wire broken in the top layer. Removing the useless end, he brought out the other, when the coil tested O. K.

"Now take the coil back, and don't keep your man out of the use of his telephone."

"That is the kind of boys I train," said George, when William had departed.

"That is a new one," said Johnston. "Did you ever think of anything like that?"

"No, by Jingo, I never did. Did you?"

"No, and you know it always takes some fool kid to think of a thing like that. Do you know what a helper of mine did in Warren? The battery zinc got broken so that he could not connect it in, and that kid actually got a piece of No. 14 galvanized steel wire and used it in place of the zinc, and never went near the battery for three days, and nobody found out the difference till he brought the piece of wire back and told me what he had done. Of course, the zinc coating was pretty well eaten off, but there was still enough left to work the battery a day or two longer."

"Well, said George," this kid of mine will either make a smart telephone man or turn up in the penitentiary. I don't know which. I never have to tell him anything but once, but like all boys, he is careless, and I have got to keep an eye on him more or less; but then, boys are not perfect. I have got to keep him in check, of course, or he would take charge of this office and order me around, but for all that I'll put him up against any boy in this part of the State."

"Look out that he don't learn too fast, and try to get your place," said Johnston laughingly.

"I think I am old enough to take care of that," said George.

SOME POOR CABLES.

"Now," said George, "we have another cable on the roof that is very bad—so bad, in fact, that any wire in it will show a slight ground—and as the cable is only about sixty feet long, that looks bad for the insulation. It is a homemade cable, consisting of common annunciator wire drawn into a rubber hose."

"H-m-m, better have left the hose off," said Johnston, "the plaguey thing is probably full of water, or at least dampness."

"That's what I think. Now here is a lot of No. 18 weatherproof wire, which seems to be pretty good, and I think we had better make up a cable of that to take the place of that other one, and we will put no covering at all over this one, but merely lash it together, not too tightly, but just tight enough to hold it in shape, so that if it gets wet it will dry out again. I would much prefer rubber-covered wire, but we haven't got that."

With this they went industriously to work, and by night they had the cable up, and some of the wires changed over, and by 10 o'clock the next morning the change was complete.

When the old cable was taken down it was found, as suspected, very damp on the inside, and the wire was laid out to dry, after which it was used for various odds and ends around the shop.

"No more rubber hose around this exchange," said George.

"That's right," said Johnston.

"There is only one way to make an outdoor cable of annunciator wire," he continued, "and that is to inclose it in a lead pipe and seal up the ends with some of the paraffin or asphaltum compounds, so that moisture cannot get in. In that way a short length of this kind of cable is practically as good as any.

"Now," said George, "as we have finished this work, we will go out over the lines this afternoon, and see what we need to put this plant in order for the winter, for there have been all kinds of work — good, bad and indifferent — done here. We can all easily put in a month fixing up things, but we will spend a half a day looking the ground over, and see which part needs it the worst."

(*To be continued.*)

"AFTER perusing the issues of your journal . . . . we are highly pleased with its contents and the stand it has taken on the side of the independent telephone companies throughout the United States, and would recommend that every independent telephone company give it the hearty support it so richly deserves. C. W. FARR, Prest."

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CHICAGO, DECEMBER, 1898.

"MAY the coming year be your happiest," is the sincere wish ELECTRICAL ENGINEERING extends to all its friends.

IN this issue we give the first of a series of articles on selective signaling systems, contributed by Mr. Thomas C. Drake, who has given years of study and experiment to that and other branches of telephony. It has long been recognized that if a system of individual or selective signaling could be devised, which would enable any station on a party line to be picked out or selectively rung to the exclusion of all others on the line, it would constitute an ideal toll line and small exchange system. To this end inventors have proposed all conceivable combinations of electrical and mechanical devices in endeavoring to perfect a system and solve the problem. Nearly all the work in this line has been of a complicated nature, both in the mechanism itself and the method of operating it, and, hence, could never come into general use, no matter how efficient it might be.

The practicable system for general application will be devoid of all complicated mechanism, and there is, therefore, a doubt as to whether it will ever be a success, because it will not be possible to construct a step-by-step device on the plain order, as is the case with magneto generators and ringers.

How near Mr. Drake has come to the solution of the problem we leave to the judgment of our readers, all of whom will, no doubt, be interested in this promising branch of telephony.

THE acquisition by our country of a number of foreign possessions opens up a new field to our manufacturers that is well worth cultivating, and which will undoubtedly yield large returns to those who are quick to take advantage of the favorable conditions created by our new territories. In the Hawaiian Islands five or six telephone exchanges have been in operation for some years, and soon after the annexation of that territory some large shipments of telephone and switchboard material were made by one of our Chicago manufacturers. Another firm reports inquiries from Cuba, where several companies are being organized for the construction of telephone and telegraph lines. With the advantages of superior skill and efficient design in the construction of independent telephone apparatus our manufacturers need fear nothing from competition on the part of any other country.

MR. A. J. LITTLE, Treasurer and General Manager of the Calhoun County Telephone Company, made a visit of several days to Chicago a week ago. Mr. Little is well pleased with the operation of his new exchange at Battle Creek.

WESTERN TELEPHONE CONSTRUCTION COMPANY DEFEATED.

The suit of Stromberg & Carlson against the Western Telephone Construction Company, Chicago, which has been pending for several years, was decided on November 18 last in favor of Messrs. Stromberg & Carlson, the jury awarding royalty to the amount of $302. It seems to have been a compromise verdict, the plaintiffs having asked for $12,000. The action grew out of the failure on the part of the Western Telephone Construction Company to carry out its contract with the plaintiffs to pay them a royalty on every magneto telephone made by it during the life of the patent. The defendant also agreed to make not less than a specified number of instruments per year. The Western Telephone Construction Company defaulted in the payment of the royalties, and about a year ago the suit was brought. Messrs. Stromberg & Carlson, through their attorneys, Messrs. Ludington & Jones, have asked for a new trial.

NORTHWESTERN ELECTRICAL ASSOCIATION.

The coming midwinter convention, to be held at Milwaukee next month, promises to be one of the most successful and enjoyable ones ever held by the association. While the complete programme has not yet been prepared, all indications point to an interesting meeting. Some half dozen valuable papers have already been promised, and the programme promises to be a full and interesting one. The "Question Box," on a new plan, will be a feature of the convention. Enjoyable entertainment plans are in progress and, as always, the members and guests will have a good time. The time, location and plans for next summer's meeting will be decided upon, and, all in all, the convention promises to be another of those enjoyable gatherings that make Milwaukee famous.

Secretary Mercein desires to have it generally known that all persons interested in electrical matters, whether members or not, are cordially invited to and welcome at the conventions.

PERSONAL.

MR. J. G. IHMSEN, general manager of the Keystone Telephone Company of Pittsburg, was among the Chicago visitors a few days ago. Mr. Ihmsen is one of the pioneers in the telephone business and a strong advocate of the independent movement.

MR. FRANK ARMSTRONG, president of the Armstrong Construction Company, Traverse City, Michigan, spent several days in Chicago last week, looking after some large orders for material and supplies. Mr. Armstrong's company has several large exchanges in course of construction and he reports the condition of independent telephony throughout Michigan as most favorable. The new exchange for the Calhoun County Telephone Company, at Battle Creek, Michigan, is one of the model plants just completed by the Armstrong Company.

MR. FRANK E. COLBERT has been appointed Western representative of the *Electrical Review*, with headquarters in the Old Colony building, Chicago. Mr. Colbert for some time past has been connected with the electrical department of the Miller & Knoblock Company, and previous to that time spent several years East, engaged in the electrical and street railway supply business. Mr. Colbert is a young man of much energy and high integrity. His general acquaintance among the electrical trade and the fact of representing such a high-class publication will make it an easy matter for him to obtain a large share of the business. ELECTRICAL ENGINEERING extends its best wishes for his success.

CHICAGO EDISON COMPANY is advertising a complete stock of the celebrated Hardtmuth carbons, both solid and cored, for direct-current arc lamps. Having received a large consignment of these carbons before the new tariff went into effect, the company is enabled to make very low prices, and consumers of carbons will undoubtedly be quick to take advantage of this fact.

"I CONGRATULATE you on your enterprise." L. A. CARR.

SOME LATE AMERICAN APPARATUS.

The American Electric Telephone Company, Chicago, is constantly producing some exceptionally fine specimens of apparatus on their regular orders. Our illustration, Fig. 1, gives an excellent view of the apparatus. It is fitted for fifty metallic circuits and has the new Bell type tubular drop (see Fig. 2), which on account of its high impedance

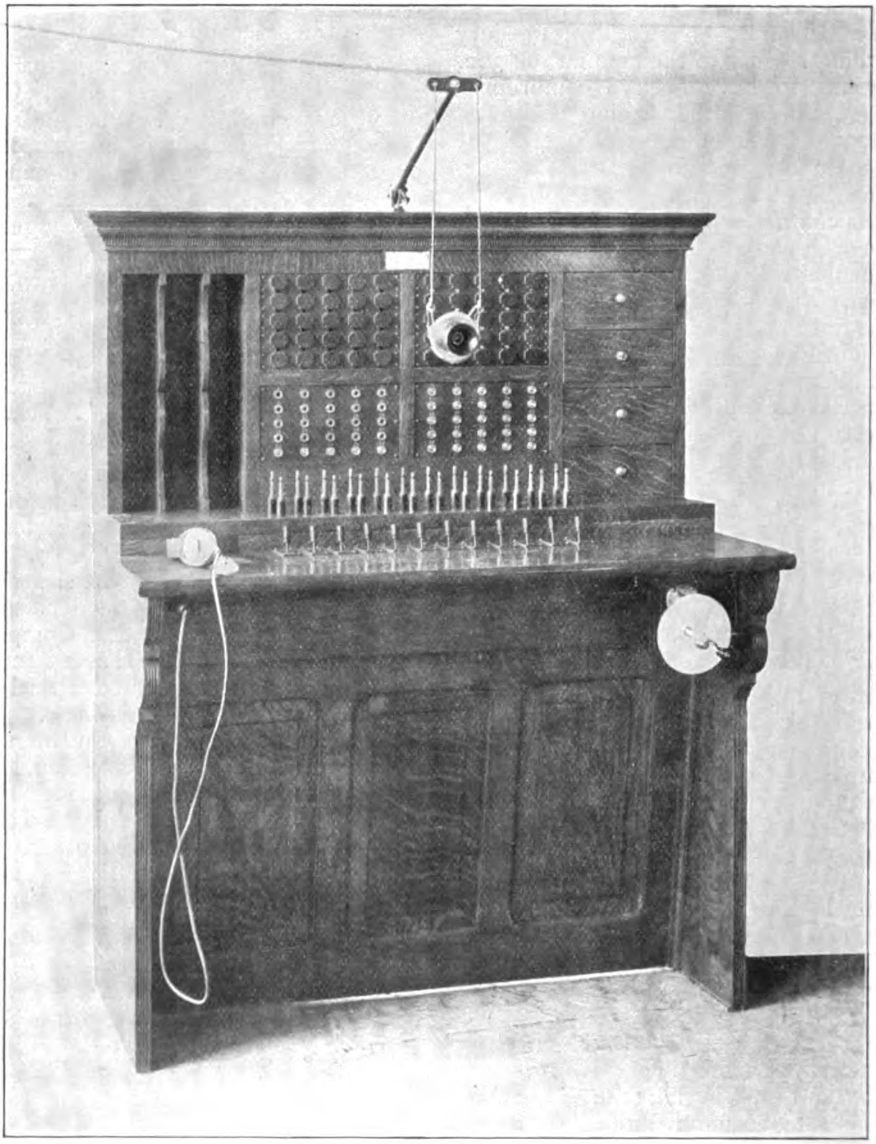


FIG. 1.

Among the recent productions may be mentioned a new toll-line board, in which can be found the most elaborate construction in the way of cabinet work ever applied to that kind of apparatus. is especially adapted to toll-line work, being probably the only drop on the market desirable and efficient for toll-line purposes. The coil of this drop can be easily and quickly removed without

interfering with the adjustment of the armature, while the air gap is so small and the adjustment so accurate that the shutter will fall easily with ordinary series magnetos. Hence, it is not necessary to change the bells or ringer coils to

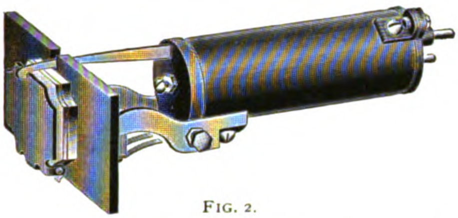
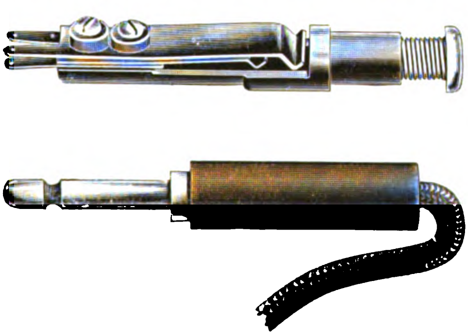


FIG. 2.

properly balance the resistance of line. The drop has been tested and found to fall readily through 11,000 ohms, while nearly all other makes were found to ring only fairly well through 5,000 ohms.

The Bell type cam used on this board (Fig. 3) is another valuable feature commending itself to the intelligent exchange manager. It is used in listening and ringing both ways on the line, and presents an entirely new feature in only one lever being used to operate it, where in other styles either two levers or two push buttons and a lever are used. The handle is made to assume three different positions, and remains automatically in whatever position placed, falling, however, readily to its normal position



FIGS. 4 AND 5.

when touched by the finger. The improved Bell type jack and plug (Figs. 4 and 5) have also some novel features, a stiff spiral spring at the cord terminal doing away with all soldered connections and securing good contact, while the screwing up of the shell securely fastens the other end of the cord. In the jack the adjustable clamping end is quite a valuable feature, allowing for any variation of the thickness in the board.

The American Electric Telephone Company, with a factory capacity that enables it to turn out over 100 drops in switchboard equipment per day and a corresponding number of instruments, is still somewhat behind in filling its orders. This is certainly an evidence of a gen-

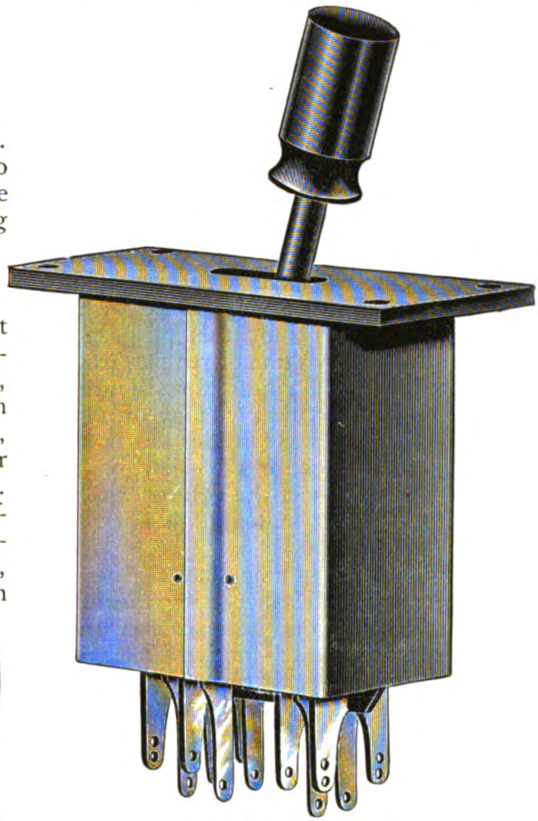


FIG. 3.

eral prosperous business condition, and an increase in manufacturing facilities will, no doubt, have to be made in order to satisfy the demands of the company's customers. Among the recent orders and shipments made by the company was a complete 700-line exchange equipment to Victoria, B. C., and a large quantity of exchange apparatus to Honolulu. Tokyo, Japan, is another foreign port where the American Company not infrequently makes shipments of its products.

PRACTICAL POINTS ON ELECTRICAL MEASUREMENT.*

BY W. B. HALE.

Since most commercial types of ammeters and voltmeters are direct-reading, their use is readily understood by anyone. A few suggestions may not, however, be out of place. Most especially do I wish to remind you that voltmeters and ammeters are essentially alike in construction and operation, and that an instrument which in one case indicates volts may in another indicate amperes, and vice versa. An ammeter is a low-resistance voltmeter, and a voltmeter is a high-resistance ammeter. A disregard of this simple truth has led to more errors in the use of these instruments than all other causes combined.

To make this plain to you, I shall assume that we have a battery of fifty storage cells whose voltage we wish to measure, and that for this purpose we have a Weston voltmeter reading from 0 to 150 volts. The internal resistance of the cells is so low that we may disregard it entirely and may consider the battery merely as a source of electro-motive force. We connect the voltmeter to the battery terminals and find that it reads 100 volts.

Now, let us assume that we have a means of gradually increasing the internal resistance of these cells without affecting their electro-motive force. Suppose, for example, that we slowly siphon off the electrolyte and refill the jars with distilled water, and, as we do so, watch the voltmeter needle. Does it still point to 100 on the scale? No; it is gradually dropping back. At one time it may indicate, say, 50 volts. "Is 50 volts, then, the difference of potential at the battery terminals?" you may ask. Not at all; it remains 100 volts as before, as an electrostatic voltmeter would show. If that is the case, why does not the voltmeter mark the correct voltage? Because we are now using it as a milliammeter instead of a voltmeter.

Let me make this clear to you. The resistance of Weston voltmeters averages about 120 ohms to the volt. Consequently our 150-volt instrument has a resistance of about 18,000 ohms, and the current flowing through its coils with one volt pressure is $\frac{1}{18000}$ of an ampere. In other words, it is a galvanometer which has been calibrated to give a deflection of one scale division with $\frac{1}{18000}$ of an ampere. If we raise the voltage to 100, the current in the voltmeter rises to $\frac{1}{180}$ ampere and deflects the needle 100 scale divisions.

We now see why the voltmeter needle dropped back as we increased the internal resistance of the battery, for when this resistance had risen to, say, 18,000 ohms, the maximum current the battery could send through its own resistance plus that of the voltmeter was $\frac{1}{360}$ of an ampere — just enough, in fact, to deflect the needle 50 scale divisions, which is apparently 50 volts.

If anyone is inclined to doubt this statement, let him take a 100-cell silver chloride dry battery and measure its electro-motive force with a Weston double-scale portable voltmeter, range 0-750 and 0-150 volts, respectively. He will find the reading on the 750-volt scale to be five or six volts higher than the reading on the 150-volt scale. This discrepancy is due to the comparatively high internal resistance of the battery. It is sometimes explained by saying that there is a greater "drop" through the lower resistance coil of the voltmeter under these circumstances. While such a statement is correct, I should not recommend you to employ it, as it leads to a misconception of the term "voltmeter." Whenever the conditions are such that you have a noticeable fall of potential through your voltmeter, I would advise you to look upon it as a current indicator — a milliammeter — which, for the time being, it certainly is. This assumption will simplify your work and help you to avoid many errors. If the Weston voltmeter scales were marked so as to read in milliamperes as well as volts, it would be a decided advantage.

Let us now consider the practical use of these instruments in general testing.

No doubt you have all read in the technical journals, at different times, articles describing methods of measuring

* Read before the Chicago Electrical Association, October 21, 1898.

insulation resistance, etc., with a Weston portable voltmeter; and you must have noticed that, in the majority of cases, they are a maze of symbols and formulas, in which *Vs*, *Rs* and *As* play a prominent part, with here and there a sprinkling of *Xs* and *Ys* to give the mixture a sparkle and flavor!

Now, while this is no doubt very scientific, is it not somewhat out of place in methods designed for everyday use? Have we not all had a formula slip our memory just when we needed it most? And have we not then sacrificed valuable time in looking it up? Well, in a great many cases the formula is as unnecessary as it is hard to remember. Let us see if we cannot solve many problems in electrical measurement without it.

MEASUREMENT OF RESISTANCE — GENERAL METHOD.

Connect the unknown resistance in series with a known resistance and a source of electro-motive force, such as a battery or a generator. Then with a voltmeter of suitable range note the readings — first, when it is applied to the terminals of the known resistance, and, second, when it is applied to the terminals of the unknown resistance. It is evident that these voltages will bear the same relation as the resistance at whose terminals they exist. If, for example, the known resistance is 1,000 ohms, and the voltmeter readings are 64 and 46 volts respectively, then the unknown resistance is

$$\frac{1,000 \times 46}{64} = 718.75 \text{ ohms.}$$

MEASUREMENT OF LOW RESISTANCES.

Pass through the resistance the largest current it will carry without heating, and measure the difference of potential at the terminals with a millivoltmeter. Then, C and E being known, Ohm's law gives us

$$R = \frac{E}{C}$$

This method is applicable in many cases where the Wheatstone bridge would not give satisfactory results. It is especially useful in locating crossed, open or grounded coils in armatures; also, in measuring variable resistances, such as poor contacts in switches, cut-outs, etc.

MEASUREMENT OF HIGH RESISTANCES.

I have here a Weston voltmeter reading to 150 volts. Its internal resistance is 19,600 ohms. I connect its binding posts to the incandescent system and the needle deflects 110 divisions, indicating 110 volts pressure. I then open one side of the circuit and insert a high-resistance coil. The voltmeter needle now points to 35 on the scale. Can we find out from this the number of ohms in the rheostat without using a formula? Yes; more easily without it than with it. For instance: We saw that 110 volts sent sufficient current through the resistance of the voltmeter (19,600 ohms) to deflect the needle 110 divisions. In other words, with 110 volts pressure

110 divisions deflection indicates	19,600 ohms total resistance
1 division deflection indicates	$19,600 \times 110 = 2,156,000$ ohms
35 divisions deflection indicates	$2,156,000 \div 35 = 61,600$ ohms

This gives us the total resistance in circuit, and subtracting the resistance of the voltmeter, we have as the value of the rheostat, $61,600 - 19,600 = 42,000$ ohms.

Following is the rule: Multiply the number of ohms in your voltmeter by the number of volts you are working with. This gives the "constant" for that voltage. Then note the voltmeter reading when the unknown resistance is added to the voltmeter circuit. Divide your constant by this reading, and the result, minus the resistance of the voltmeter, is the number of ohms in the unknown high resistance.

MEASUREMENT OF INSULATION RESISTANCE.

In insulation-resistance work the voltmeter resistance may usually be disregarded, it being insignificant in comparison with the very high resistance we are measuring. The operation is then extremely simple. To find the insulation resistance of an electric-light main, for example, ground one binding post of the voltmeter and connect the other to the main that is clear. Divide the scale-

reading thus obtained into your constant, and you have directly the insulation resistance in ohms of the faulty main.

If both mains have leakage to ground, the foregoing test should be made on each side of the circuit. Then the voltmeter constant divided by the sum of the two readings will give the insulation resistance of the entire system. A formula is by some considered indispensable in this test. Would they use a formula to calculate the current flowing through a divided circuit, or would they insert ammeters into the several branches and add the ampere readings? This last is practically what we have done here. When the voltmeter is connected between the positive main and the ground it indicates by its deflection the number of milliamperes of current leaking through the insulation of the negative main to ground, and when it is connected between the negative main and ground it indicates, in a like manner, the leakage from the positive main. It is evident that the sum of these readings gives us the total current that would flow through the insulation of both mains were they to be connected to one pole of the generator, with its other pole grounded.

If you wish to measure the insulation resistance of a system of incandescent wiring, disconnect the system from, say, the positive main where it enters the building, and ground that main through a lamp; then insert the voltmeter between the negative main and the entire installation. This is most conveniently done at the main cut-out, where you may remove the fuses and connect one binding post of the voltmeter to both sides of the house circuit looped together, and the other binding post to the negative main. Then ground the positive main through a lamp or fuse, and note the voltmeter reading. Divide this reading into the voltmeter "constant" for the voltage of the system, and you have the insulation resistance of the plant.

BATTERY TESTING.

A Weston portable voltmeter with a three-volt scale is excellent for tests on individual cells. Unless the battery has an abnormally high internal resistance, the voltmeter reading will represent its true electro-motive force.

INTERNAL RESISTANCE OF CELLS.

We have here an ordinary Leclanche porous-cup battery. The voltmeter shows that its electro-motive force is 1.55 volts. I close the cell through 10 ohms external resistance, and the voltmeter now indicates 1.43 volts as the difference of potential at the terminals. Now, the electro-motive force of the battery is probably generated where the chemical action is taking place; that is, at the surface of the zinc element; and when we put the cell on a closed circuit there is a fall of potential through both the external and internal resistances. We have, in fact, a current flowing through two resistances in series, and, as we have seen in our previous tests, the potential differences at their terminals are proportional to the resistances themselves.

Well, we have just found that the electro-motive force of this cell is 1.55 volts, and that its potential when closed through 10 ohms is 1.43 volts. The difference between these values, which is .12 of a volt, must represent the fall of potential through the internal resistance of the battery. Or to put it in the form of an equation:

1.43 : .12 :: 10 ohms : internal resistance of cell.

Therefore, internal resistance $= (.12 \times 10) \div 1.43 = .84$ ohm.

There are more exact means of determining the internal resistance of batteries, but this method is sufficiently accurate for all practical purposes.

SUGGESTIONS.

The excellence of the Weston portable instruments and their widespread use justify, I think, the time we have devoted to their consideration this evening. In the Weston voltmeter, in particular, we have a portable and sensitive D'Arsonval galvanometer of great usefulness. Before concluding, I should like to read you a short list of "Don'ts," made up from practical experience.

(1) Don't place the voltmeter near dynamos or motors, nor close to any large mass of iron.

(2) Don't set it down roughly, and,

above all, don't get into the habit of tapping the case every time you take a reading. If the needle sticks, the voltmeter needs to be repaired.

(3) Don't connect the three-volt coil to 110-volt mains. It would be better if the left-hand binding post of the lower scale had its value stamped in more conspicuous figures, as the small figures now used are often hardly distinguishable after the binding post has been handled for any length of time.

(4) Don't screw the portable voltmeters to your switchboard or to the wall and expect to get good results; they should always be placed on a level surface when used.

Finally, Do mark the resistance of your voltmeter and its "constants" for standard commercial voltages on a small card, and attach this to the instrument; you will find it useful. (If the manufacturers of the Weston voltmeter would stamp the resistance of its coils on the instrument itself, it would be a great convenience. They now mark the resistance only on the lid of the carrying case, and as these lids are frequently broken, lost, mislaid or interchanged, it is often difficult to find out the resistance of the voltmeter one is using.)

I will close this paper with a few words on practical units of measurement.

We have here a simple circuit of one-ohm resistance carrying one ampere of current.

The difference of potential at its terminals is, of course, one volt.

One coulomb of electricity will pass any point in this circuit in one second of time, and will charge in one second a condenser of one farad capacity to a potential of one volt.

Power will be developed in this circuit at the rate of one watt per second, and the work done in one second will be one joule.

If the current in this circuit commence at zero and rise to maximum in one second, and if during that time it encounter an opposing electro-motive force equivalent to one volt, then the inductance of the circuit is one henry.

BATTERIES FOR EXCHANGE AND TOLL-LINE USE FROM THE POINT OF ECONOMY AND EXCELLENCE OF SERVICE.

BY S. A. DINSMORE.

This is a subject about which the majority of independent telephone managers and owners seem to be groping in the dark. One manager, when asked for information on the matter, said that he thought a dry battery was the proper thing to use, and another said he thought a wet battery was the best; and when both were asked for their reasons for making these statements they could give no satisfactory reply, as neither had made any tests to actually find out which was the best. The proper way to overcome this is simply to do in reference to batteries what has been done in a great many other similar cases — follow the footsteps of our predecessors, the Bell Company, by making tests of the different makes and forms of batteries and keeping a record of such tests for future reference.

Now, the ordinary telephone exchange of one, two or three hundred numbers cannot afford to go to the expense of buying instruments for making an accurate test as the Bell Company does. But they can keep a written record of each set of batteries on a telephone — that is, a record of the time when the batteries were installed and what the items of maintenance are, such as new zincs, sal ammoniac and time of inspection.

Another point is to have all batteries inspected regularly and not wait with the recharging until your subscriber complains that no one can hear him, and then, when you look for the trouble, find that the zinc is almost entirely eaten away, with perhaps a piece an inch or two long remaining and this barely touching the solution. Again, the battery may become short-circuited in itself, not an uncommon occurrence. This trouble happens from a number of causes, the most common being that of using a poor grade of sal ammoniac, which forms crystals on the zinc, and as these crystals enlarge they finally touch the carbon and short-circuit the battery, a trouble which might have been avoided by having a regular time of inspection.

Some managers will say that having a regular time of inspection of batteries and keeping a record of same is too much trouble, but they will find by the end of the year how much more efficient the exchange is, and the cost of maintenance would be less for the reason that they would have a complete record of what the batteries on every instrument have been doing. They would also be prepared to give an intelligent answer from recorded experience, should anyone ask what was the best form of battery to use.

Many expensive tests and galvanometer measurements have been made to determine the resistance of the various different makes of transmitters in use in the United States. The majority of them were found to be of the solid-back granular carbon type. The measurements were made direct on a telephone in use, including the primary coil of the induction coil and switch contacts in the primary or battery circuit. These measurements varied considerably; the minimum resistanee was found to be about thirty-five ohms and the maximum resistance seventy-five ohms. To meet this variable resistance a battery, whether it be of the wet or dry type, with a low internal resistance and a high recuperative power in prolonged or heavy service, will be found to meet the demands and give better results in connection with the granular carbon type of transmitters than a battery with a high internal resistance.

The independent telephone has opened up the field for a good primary battery, and a considerable number of these have been placed on the market.

There are several forms of dry batteries manufactured which can be recharged from a direct electric-light current, the same as a storage battery. To do this, the positive pole of the battery is connected to the positive pole of the dynamo, which will, when the charging current is of a greater strength than that of the battery, set up electrolysis, and the chemicals which were formed during the discharge of the battery when in use are decomposed and the elements restored to their original condition. This type of battery has a low internal resistance and a good depolarizer. A great many of the cheap dry batteries on the market use for their depolarizer such substances as plaster of paris, sawdust, tan bark, blotting paper, etc., which give them a high internal resistance and a slow recuperative power. Such batteries are not suitable for telephone work, and although they may cost a few cents less at first, they will cost more in the end than a good form of dry battery when new.

A point of economy in connection with wet batteries with a sal ammoniac solution is that of using nothing but the best grade of imported sal ammoniac procurable, as all sal ammoniac of American manufacture contains a large quantity of lead. It is the lead which forms the crystals on the zinc, and of course, lead being a conductor of electricity, these crystals or needle points of the lead salt will very soon short-circuit the battery.

If this has happened, a good remedy is to remove the carbon element and soak it in lukewarm water for a few hours. Afterward wash it well with clear water and it is ready for use again, in as good a condition as at first. In fact, soaking the carbon elements of any battery as before mentioned, whether it has been short-circuited or not, will help to keep the depolarizing qualities of the battery in good condition. This should be done once every year.

There is a great economy in using a good zinc. Do not use a cast zinc in a sal ammoniac solution battery, as zinc itself will not cast readily and lead is mixed with it in order to obtain a good casting alloy, and the result is the same as that obtained through using a poor grade of sal ammoniac, namely, lead crystals or needles will form on the zinc and will sooner or later ruin the battery. Zincs made from rolled rods or those which are sheared from rolled zinc are the best and the only ones to use to avoid all trouble from the cause mentioned.

The efficiency or excellence of service in your batteries in exchange work will depend upon the care you exercise to keep them in the best condition. In the first place, if you use a transmitter of a granular carbon type, which nearly all

the local exchanges do, and you wish to use a dry battery, select a low internal resistance and a high recuperative power; but if you prefer the wet battery, which very many do, select one with a large carbon element which has a large surface, and which is more or less porous.

Do not waste time with so-called battery gauges, as no two of them will read alike. They are not calibrated, and when you do get a reading you know no more about the condition of the battery than you did before making the test. A low-reading voltmeter is the proper thing to use, as these instruments are accurate and give a reading in volts, and not simply a scale reading, 5, 10, etc., which really means nothing.

The life of the ordinary sal ammoniac battery in exchange use varies according to the number of calls of the telephone to which it is connected. Of course, the oftener and the more it is brought into action the shorter its life. There is just so much service there, and the more gradually it is used, the longer will be its life. In general, a battery of the sal ammoniac type should last six months to one year without recharging, and on heavy work from three to nine months.

The average life of a dry battery varies more than that of the wet battery. The majority of them last anywhere from three months to one year, and some of the types which can be recharged have been known to give good service for sixteen months. Batteries of this form, to give good service, should be recharged before they are entirely exhausted, as by doing this their life will be considerably prolonged.

For toll-line service the Bell Company has used almost exclusively for the past few years the Fuller mercury battery of the standard closed type with one flat carbon plate and wooden covers to prevent evaporation. The life of this battery has been found to average from fifteen to twenty weeks on one charge of solution. The actual time, of course, varies with the amount of work it is called to do. The Fuller battery, however, has its disadvantages for use in connection with local toll lines, as it requires an experienced man to install and care for it, and it also requires a great amount of attention. One point which must be watched closely in the use of the Fuller battery is to be sure of getting enough mercury in the porous cup, as any deficiency will cause crystals to form on the zinc and give the battery too high an internal resistance, which depreciates its value for telephone use.

A good form of carbon battery with the sal ammoniac solution seems to be what most of the independent companies are using for toll-line service, and which seems to be giving good results. The same care, as near as possible, should be exercised over the batteries on toll-line instruments as those on the local exchange instruments, and the economy and efficiency or excellence of service of the same will be considerably increased.

For a battery to operate the switchboard transmitter, if you have any means of recharging it, a storage battery will give the best results. This could not be used where there is no electric light plant or where there is no direct current available unless you could make arrangements to have the batteries recharged from the exciter, which is a small direct-current dynamo used to generate a current to magnetize the field coils of an alternating-current generator. If the batteries were of about 300-ampere-hour capacity, it would not be necessary to recharge them more than twice a week and possibly only once a week. This all depends, of course, on the amount of current consumed by the transmitter. If there is no facility for charging storage batteries, the next best thing is to use some good form of closed-circuit battery, of which there are a number on the market; and as it is not intended here to to advertise any particular makes of battery, it can be stated that some of these batteries are all right and others are not worth trying. The gravity battery, if well taken care of, will give fairly good service on a switchboard transmitter.

In using a storage battery on more than one set of operators' instruments, it is necessary to be sure and run the primary wires of each operator's set directly to the battery, and not try to work them by running a heavy main line from the battery to the back of the switchboard and connecting the primary

of the operator's set to it. The effect of such a connection is to set up cross-talk on all the lines so connected, and the result is confusion and interminable worry. This is one of the little occurrences in telephone battery work that have often worried the manager.

If you have good facilities for recharging storage batteries and the haulage is not too great, it is much more economical to use them on exchange instruments rather than a primary battery. One of the smallest forms of storage battery at each telephone gives good results. The actual life of the storage battery varies according to the ampere-hour capacity of the battery and the amount of service it is called upon to give.

A battery of any kind is like a coffee-pot or brown jug. The oftener you go to it and the longer you stay, the sooner you will have to go to the grocery for more. In using storage batteries on the exchange instruments it is a good plan to number each battery, and make and keep a record of the number of times it is used and how long it is in service each time. By doing this, in a few months' time you would be able to determine the exact time a battery on a certain telephone would have to be recharged, and thus bring your batteries down to an economical basis and obtain the most efficient and satisfactory service possible.

EUREKA EXPRESS SWITCHBOARD.

The Eureka Electric Company has just placed upon the market a new Express metallic switchboard, which is claimed to be one of the most rapid and simplest telephone switching apparatus ever devised. It is a radically new departure, and for rapidity of operation, simplicity of construction and economy of maintenance, is claimed to be unequaled. Each jack and drop is self-contained, and can be removed and replaced by anyone in less than thirty seconds without the use of a tool, and without disturbing a line connection.

The boards are built in 100-line frames, beautifully finished in quarter-sawed oak, and so arranged that additional cabinets of 100 drops each can be added from time to time as may be required. With each operator's set of 100 drops are furnished ten pair metallic plugs and reinforced cords, a switching key, a hand generator and a Eureka long-distance amplifying solid-back transmitter. The cords are so made that they allow a set screw clamping them into the plug handles, so that there is no strain upon the tinsel strand. This arrangement makes it impossible to pull a cord from the plug in service. The cord may also be bent close up to the plug without danger of breaking the conductors. The switching key in front of each operator is all that is required, as no ringing or listening keys are necessary. The hand generator is guaranteed to ring through

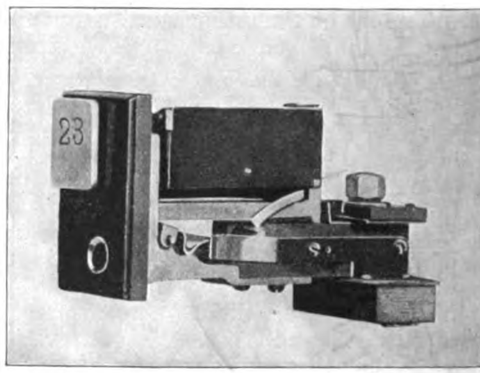


FIG. 1.

35,000 to 40,000 ohms, and gives a current of great quantity. This makes it equally adaptable for short series lines or for long bridged circuits.

The Eureka transmitter, with its improved construction and metal back, does away with all vibratory motion, and is claimed to be more serviceable and firmer than any of the wood-back type. It is hung from a neat arm, made adjustable as to height and distance from board. The induction coil is silk-wound, has rubber heads and all connections are soldered. A night alarm switch and cell are, of course, provided and gravity batteries furnished for transmitter and night bell. The rapidity of operation of this board is claimed to be of the highest, so much so that in one exchange of 300 subscribers one operator is sufficient to answer the calls.

The operation of the drop, shown in detail in Fig. 1, is a very interesting

departure from other types of self-restoring drops. In place of the drop falling upon the board, in the Eureka Express it drops sideways, as shown in Fig. 2, which clearly conveys the manner of falling. In nearly all other forms, any jarring of the frame by the operator or otherwise usually causes several other drops to fall, thereby causing much confusion. In the Eureka Express this cannot happen, because, owing to its peculiar action the drop can only fall when the magnet has been magnetized. Upon receiving a call, the operator takes a plug, and by the same movement that inserts the plug in the jack, connects her set with the calling subscriber. Hence,

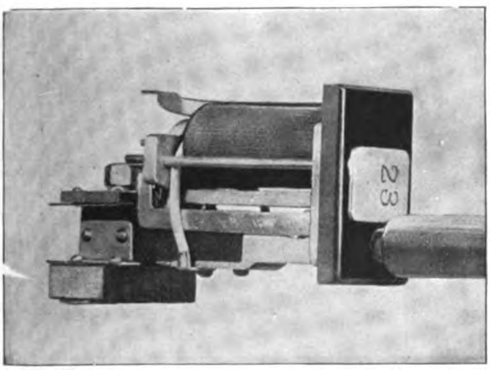


FIG. 2.

she does not have to throw nor pull any listening cams, the insertion of the plug making the circuit. After learning the number desired, she takes the other plug of the cord and inserts it in the jack of the number wanted, which immediately rings up the subscriber, when a slight movement of the switching device throws the two circuits together. The same movement automatically cuts out the ringing circuit and operator's set. For listening, a slight movement of the switch will throw the set in. The ring-off from either side will drop the clearing-out drop of the circuit, which is the drop that made the call, the called drop being out of circuit. Withdrawing the plugs mechanically restores the drops.

These boards, the Eureka Company announces, are built in any capacity desired. For large exchanges the company provides a transfer system, which is equally efficient and reliable.

SOME NEW EXCHANGES.

LACON, ILL.— An independent telephone exchange will be in operation here by January 1 next, Mr. Van Antwerp, of Sparland, having secured a franchise for that purpose.

MASSIES MILL, VA.—W. D. Meeks, James Dickie, J. C. Bentz, B. M. Hughes and others have organized the Massies Mill Telephone and Telegraph Company, with a capital stock of $2,000.

JANESVILLE, WIS.— A new independent telephone company is about to be organized here. Some four hundred to five hundred subscribers have been secured, and the rates will be about half of what the Bell is charging at present.

ST. PETER, MINN.— The St. Paul and St. Peter Telephone Company has been given a charter to construct and maintain a telephone exchange. Capital stock is $10,000. H. P. Proctor, August Proctor, Frank A. Chase and others are the incorporators.

GRAND RAPIDS, MICH.— Messrs. Fuller & Perkins are organizing a stock company to establish a complete telephone exchange system to cover Mason, Oceana and Manistee counties. The promoters agree to furnish service at one-half the Bell rates.

NAZARETH, PA.—The Slate Belt Telephone and Telegraph Company is reconstructing all of its lines for metallic circuits. Over $10,000 will be spent in construction, and new switchboards placed at Nazareth, Bangor, Pen Argyl and Wind Gap. Mr. Rollo Stier is superintendent, and under his efficient supervision the plant will, no doubt, become a model one.

BAY CITY, MICH.— The Valley Telephone Company is now furnishing service to Detroit, a through line having been completed by way of the Flint route of the New State Telephone Company, of Detroit. The line is now in perfect working order, and giving the best and most efficient service. Other improvements being made by the Valley Company will soon give its patrons almost complete State connections.

A MODEL CENTRAL ENERGY EXCHANGE.

The system of the Calhoun County Telephone Company, when completed, will comprise the exchanges at Battle Creek, Albion, Marshall, Bedford, and a network of toll lines throughout the county, connecting all the small towns and many of the representative farmers. The system now has connection with more than three hundred towns and cities in the State, enabling any subscriber in the entire plant to communicate with any of these stations, extending from Michigan City, South Haven, St. Joseph and Benton Harbor, on the west, to Detroit on the east, and from South Bend, Indiana, on the south, to Cadillac, Michigan, on the north.

The present company was organized nearly a year ago, with Mr. L. McCoy, of Battle Creek, president; Mr. H. L. Kochersperger, of Chicago, vice-president; Mr. S. A. Howes, of Battle Creek, secretary, and Mr. A. J. Little, of Battle Creek, treasurer and general manager. The citizens of Battle Creek, with their usual activity and interest in patronizing home industries, came bravely to the front, and are standing by the independent telephone system regardless of the fact that the Bell company has reduced its regular rates to $6 a year, for the purpose of crippling the independent movement.

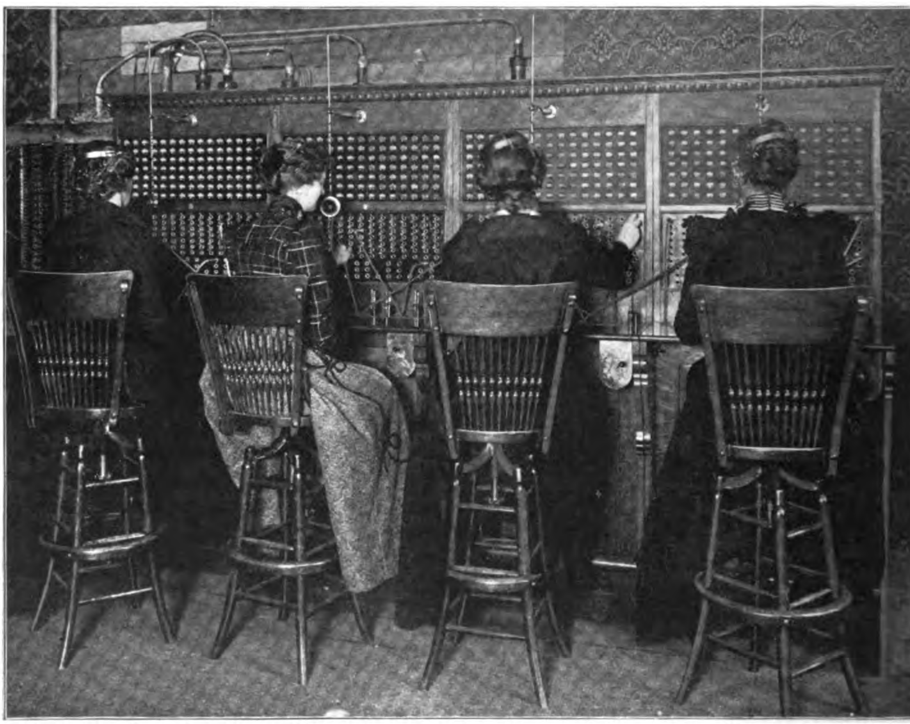


FIG. 1.

The business of the company was left entirely in the hands of General Manager Little, who thoroughly investigated the construction and equipment in many of the largest exchanges throughout the West before making any arrangements for building their plant.

Knowing the great opposition that a system of that size and importance in the State would receive, and desiring to give their city and county the best service possible, they gave the contract to the Armstrong Construction Company, a home company, who would themselves take special interest in the plant, to

build the plant with full copper metallic construction, using cable wherever practicable, and equip it with the Central Energy System manufactured by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago.

The construction was done under the direct supervision of Mr. Frank Armstrong, president of the construction company, and one of the oldest telephone, telegraph and electric light plant construction men and managers in Michigan.

The exchange at Battle Creek, the center of the county system, was the first to be installed. Owing to the eagerness of the subscribers the exchange was opened for operation about three months ago, when the first twenty-five instruments had been connected. The company now has about five hundred subscribers. In the outlying districts some are being temporarily connected on party lines.

The exchange and general offices of the company are located on the second floor in the Post Office Block, on Canal and Jefferson streets. The exchange is in charge of one of the best corps of operators and a superintendent, who put forth every effort to please the public.

Fig. 1 shows the exchange switchboard. The board is made up in sections of 100 lines each, and has trunking capacity for a 1,000-subscriber exchange. Additional sections may be added as required without altering the original equipment.

The trunking jacks are placed immediately underneath the subscribers' jacks. The board is well protected from lightning and other heavy electrical currents, by S.-C. fuse and carbon lightning arresters. The cables enter the office and terminate in pot-heads which thoroughly protect the paper-wrapped cables. From the pot-heads a rubber-covered wire is used to the lightning arresters.

FIG. 2.

Fig. 2 shows the manager's office, showing several portable desk instruments, the State line-testing board, wall style, and the toll-line switchboard. The toll board is equipped for ten toll lines and has three trunking jacks to each section of the exchange board. It is also furnished with monitor spring jacks, enabling the State line operator to talk direct with any operator on the exchange

board or to listen in on the operators' circuit without ringing. The testing board is for testing the long-distance, through-State trunk lines.

Each line equipment in this board consists of a high-wound ringer and bells, and three especially designed spring jacks. One jack is for making connection between the through trunk line and the local toll-line switchboard. At the other two jacks either wire of the line can be connected to the ground or the lines opened or short-circuited.

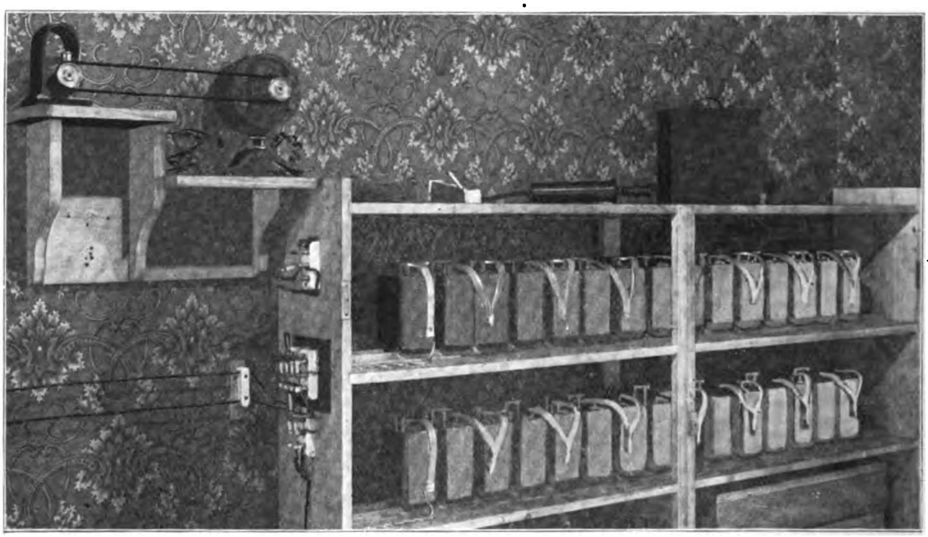


FIG. 3.

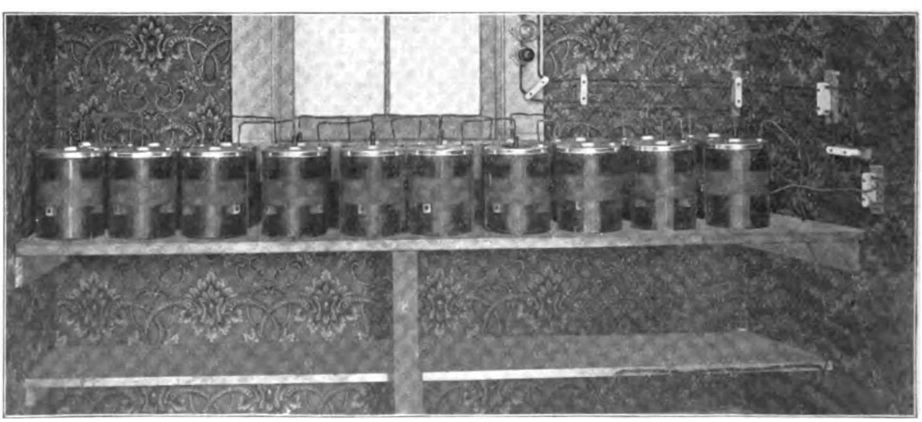


FIG. 4.

This enables an operator to test the line either way for any trouble on the lines or to readily learn if the trouble is in the office instrument. This equipment was manufactured by the S.-C. Company for W. T. Heddon, superintendent Central Telephone Company, Kalamazoo, Michigan, for use at the various stations on their State toll lines.

Fig. 3 shows the main talking and ringing energy plant. The power generator shown furnishes the current thrown on the line when a subscriber pushes the

button to signal central. It is run by an electric motor driven by a 550-volt electric power circuit. The battery plant shown supplies the entire talking energy for the subscribers' instruments, as well as the operators' telephones. It consists of two batteries, each of fifteen storage cells. The batteries are also charged from the power circuit, one set being charged while the other is in use.

By means of the switch at the side of the battery shelves either set is thrown into operation on to the system, and at

FIG. 5.

the same time the other set is thrown on to the charging circuit. Either one of these sets can also be used for a subscribers' ringing-in battery.

Fig. 4 shows a Gordon primary battery plant, used in case of an emergency. The battery can be used for furnishing power for ringing, in case of accident on the power generator, or for talking energy, should the storage batteries at any time fail, thereby guarding against any possible interruption to the service. The switch shown above the emergency plant is used for throwing off the charging current from the storage plant.

Fig. 5 shows a police box equipped with an S.-C. double-pole receiver and long-distance transmitter. These transmitters and receivers are especially adapted for such purposes and can be used with any make of police system.

The receiver, having all parts firmly clamped in the brass adjustable head, which is securely locked when in proper adjustment, makes it practically impossible to become out of adjustment or be affected by the greatest variation of temperature. The cord, running directly into the shell, leaves no binding posts to break and cords to become loose and disconnected. The transmitter being sealed and the heavy metal diaphragms protected with an auxiliary diaphragm of weatherproof material, prevents it from getting out of order from dampness, to which instruments in these places are subjected.

The telephones in this system are supplied with battery from the central at police headquarters, thus leaving no batteries to deteriorate, freeze or otherwise become out of order at the various stations. The police telephone system can be connected at police headquarters with the public exchange, thus enabling a patrolman to call up any subscriber from any one of the patrol boxes. This feature is very desirable late at night, when public telephone stations are closed.

There are also a number of private plants, both intercommunicating and central station systems, connected with the exchange.

The construction of the exchange includes a strictly metallic copper circuit, a large amount of Roebling's paper-wrapped cable being used on the principal leads. The construction was put in under the most difficult circumstances. There were already two electric light lines, Western Union and Postal lines, trolley circuits and the Michigan Bell Company's lines. There were also more than the usual number of shade trees.

Fig. 6 shows a pole on Canal street, one block from the central office. The cables terminate in a pot-head where the paper-insulated cable is connected with rubber-covered wires, and then the head filled with a rubber compound to prevent moisture entering the cable. The

rubber wire is then connected with one side of a fuse strip in a cable box, and the other side of the fuse strip is connected to the line wire. This thoroughly protects the cable from lightning, moisture, etc., and leaves no possible chance

FIG. 6.

for an unsoldered connection becoming loosened from the constant swinging of the line wire and to become corroded or rusted from becoming wet. The cable pole, being provided with a platform, makes it convenient to readily change any fuse that may be destroyed by lightning, etc. This style of protection is the most inexpensive and leaves the least possible chance for trouble in the system.

With outside construction put up in this way, in a substantial manner and with the exchange equipped with a system of this type, it can cost but very little for maintenance and require practically no attention outside of the central office. The simplicity of the equipment and the great efficiency of the central energy system is a marvel to telephony in general.

INDEPENDENT ITEMS.

REINBECK, IOWA.— The Iowa Telephone Company has been granted a franchise at this place.

NORTH SALEM, N. Y.— W. E. P. Finch and J. Hunt, Jr., have organized a local telephone company at this place.

WYMORE, NEB.—The new telephone exchange to be established here is now an assured thing, as sufficient subscribers have been obtained to secure success.

PORTSMOUTH, OHIO, will soon have a telephone exchange. The cost will be about $15,000, and it is expected that the plant will be in operation by February next.

HARTFORD, KY.—The Ohio County Telephone Company has been organized and incorporated. The business of the company will be to operate lines in the county.

SEATTLE, WASH.— The Pacific Automatic Exchange Company has elected the following officers: W. E. Price, president; G. P. V. Lansing, secretary, and J. D. Hodge, treasurer.

POTSDAM, N. Y.— The Racket River Telephone Company will operate lines in this town, Canton and Norwood. Capital is $6,000; directors, J. O. Crawford, of Hamden, and others.

FALLECK, CAL.— The Falleck Telephone & Automatic Switch Company has just been incorporated with a capital stock of $100,000 by A. K. Andriano, W. T. Hess and others.

SCRANTON, PA.—A movement is on foot to secure a franchise for a new telephone exchange here. Messrs. Charles Robinson, A. P. Bedford, W. J. Lewis and others are interested.

SNOW HILL, MD.— The Worcester County Telephone Company has been organized to construct an exchange. Dr. George Bishop, C. J. Prunell, J. P. Monroe and W. S. Powell are interested.

GALVA, ILL.—The Galva Telephone Company has now over two hundred 'phones put in and still more are to be connected. It will be only a short time now before all subscribers are connected, and indications are that some three hundred 'phones will be in operation before next year.

SPRINGFIELD, OHIO.— Mr. F. W. Marsh has applied for a franchise for establishing a new independent telephone exchange in this city. The rates promised are $30 and $20 respectively, and some nine hundred subscribers will avail themselves of the new service.

PEORIA, ILL.— The Citizens' Telephone Company is proceeding rapidly with its construction work. The company expects that it will have its lines ready for operation by the first of May next. The better rates and better service of the new company will be highly welcomed by the citizens.

MONTGOMERY, ALA.— W. F. Vandiver, F. M. Billing and others, have been granted a franchise for an independent telephone exchange in this city. The ordinance is not exclusive, and provides free of cost to the city the top cross-arm of each pole for police and fire alarm wires. The rates for service shall not exceed $36 for business houses and $24 for residences per year.

SEATTLE, WASH.—A new telephone company will soon be in operation throughout the State of Washington, and will be called the Pacific Automatic Telephone Exchange Company. Articles of incorporation have been filed by H. C. Henry, W. E. Price and F. D. Schuyler. An automatic system will be used, and among other places Seattle will have an exchange. Some five hundred subscribers have already been secured.

NEW ROCHELLE, N. Y.—The new Rochelle & Westchester Telephone Company has been incorporated with the secretary of State. The capital stock is $150,000. The directors are George W. Dutton and Joseph Claudet, of New Rochelle; Fred R. Kellogg and Horace A. Connor, of Brooklyn, and others. It is proposed to operate a telephone system in New Rochelle and the neighborhood, and to extend the lines to New York and other large cities.

MONTHLY DIGEST OF TELEPHONE AND KINDRED PATENTS

EDITED BY EDWARD E. CLEMENT.

Copies may be had by inclosing 5 cents and postage for each one. Address inquiries in care of this magazine or to McGill building, Washington, D. C.

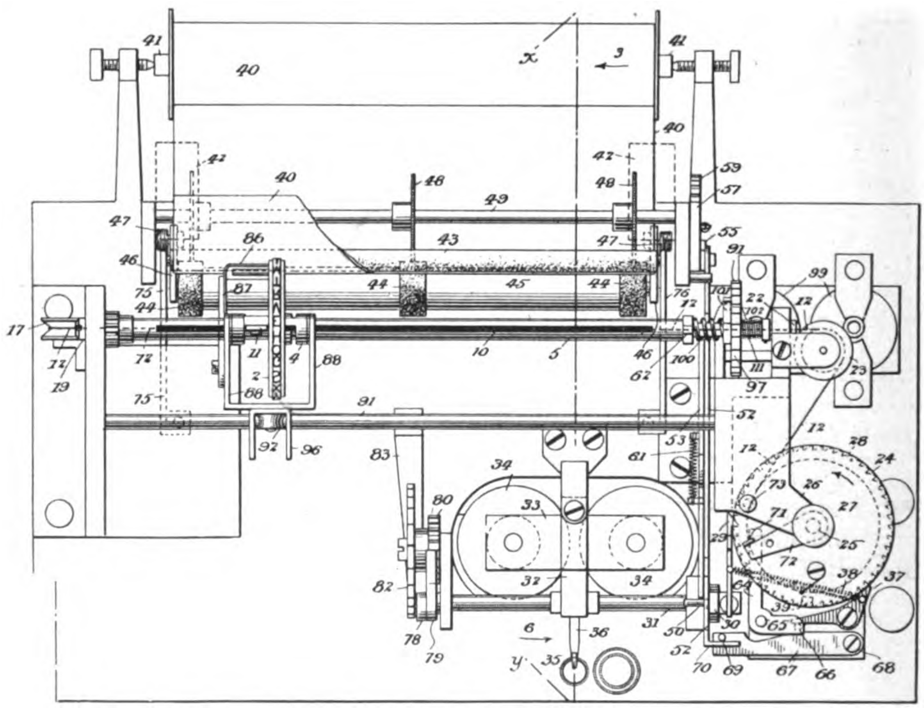
November 1.

613,286.—C. H. LONG. EMERGENCY FUSIBLE CUT-OUT FOR ELECTRIC CIRCUITS.

This invention, while primarily intended for use in electric lighting circuits, is of interest as containing an idea which might well be applied to telephony. It consists of the ordinary fusible link inserted in a circuit, together with a switch which may be thrown to close the circuit after the link has been fused, the switch itself serving to reunite the terminals through a small fusible link of its own.

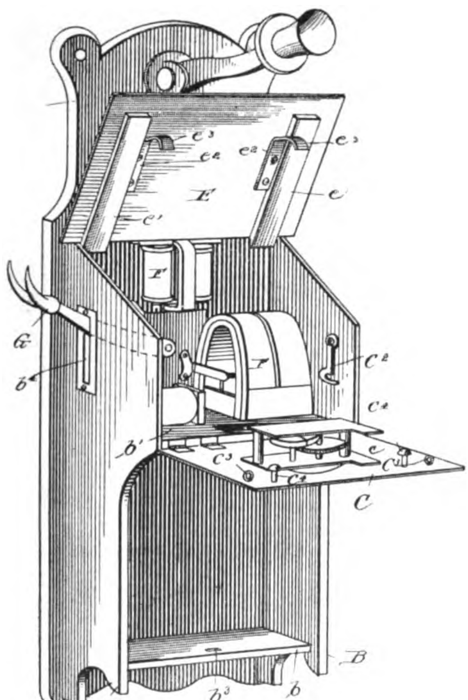
613,348.—A. WIRSCHING. PRINTING TELEGRAPH.

This invention relates to that class of printing telegraph receivers in which a rotary type wheel, in addition to a rotary movement about its axis, is caused to move across the paper, by which means what is known as "column" or "page" printing is done. The description of this device in detail is lengthy and involved. In brief, it comprises a rotating hollow shaft carrying the type wheel and provided with a longitudinal slot in which rides a feather on the wheel, a motor for driving the shaft constantly, means for stepping the wheel along the shaft as it prints, means for returning the wheel to the beginning when at the end of a line, and means for feeding the paper. For stepping the wheel along for "letter spacing," a toothed wheel is provided operated by a pawl, which in turn is operated from the printing magnet. A cord or wire passes through the axis of the hollow shaft referred to, and is attached to a traveler, and then, passing to the other end of the shaft, is wound on the spacing drum rotated by



613,348. PRINTING TELEGRAPH.

the printing mechanism. At its starting end the cord is held under tension by a spring drum, which, when the stepping device is tripped, retracts the traveler and thereby causes the printing wheel to begin a new line. The line spacing is accomplished by means of a special key at the transmitting end, which holds a detent in the path of a rocking lever to cause a pin controlled by the printing magnet to transmit its motion to a pair of pawls — one moving the paper a half step on the forward stroke and the other



613,533. TELEPHONE CABINET.

on the backward stroke — the pawls acting on a toothed wheel which rotates the paper rolls. Stops are provided which act to prevent overspacing, and also stops to prevent the wheel mechanism from being thrown violently back against solid parts of the machine in retraction. The printing magnet moves a platen to print, and a guard is provided having an opening the height of a type face to prevent other characters from making any impression. The paper feed is continuous, rolls being employed; and an ordinary unison device is used. The type wheel travels in a frame which is steadied by a guide rod similar to the front rods of ordinary typewriting machines. The entire machine is inclosed in a case — preferably of glass — and the paper fed in and out, so that access to the interior is unnecessary. There are many details of construction.

613,533.— I. SPARKS. TELEPHONE BOX OR CABINET.

The invention in this case is a box or cabinet for attachment to the ordinary backboard, having special provision for the arrangement within it of calling and signaling means as used in automatic telephone exchange systems. It consists in providing a cabinet having a horizontal partition, and an upper and a lower door. The lower door screens the batteries, which are arranged below the partition, while the upper door is hinged and carries the selective signal transmitter. Above the partition and behind the transmitter the generator and the ringer are arranged.

November 15.

614,207.—W. E. M. JACKSON. TELEPHONE EXCHANGE SYSTEM.

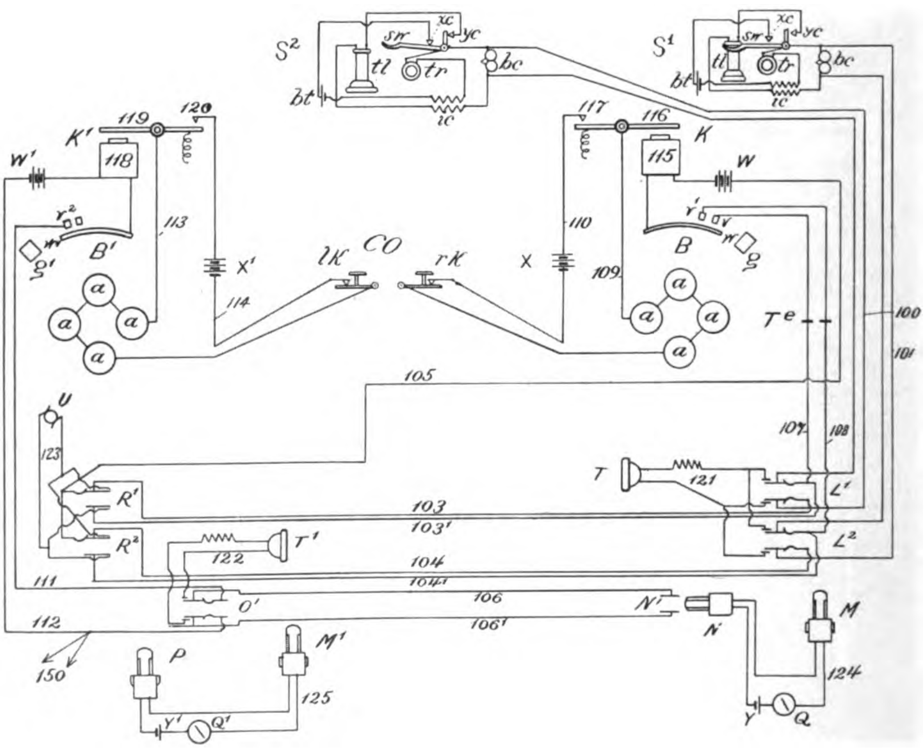
The invention in this case consists, in the main, of an application of the system of signaling apparatus for which patent No. 536,210 was granted to the same inventor March 26, 1895. A signaling wheel is employed, around whose periphery the numbers of the subscribers are arranged, and which is kept constantly revolving. A small aperture in the switchboard is provided through which one number at a time becomes visible, A magnetic brake is arranged to stop the wheel when its circuit shall have been closed by a relay which is put under the control of each line in succession as the wheel revolves. When a calling subscriber closes his circuit, therefore, the relay will be energized when his line is reached and the wheel thereby stopped, exhibiting his number through the aperture. When the operator inserts the answering plug the line is disconnected from the relay and the wheel again revolves. Each line is connected to an answering and

also to a calling switchboard. The various boards are interconnected by trunk lines. Each calling board is designated by a letter or numeral, and the terminals are arranged thereon in sets of, say, one hundred. The subscriber, when calling, gives the answering operator the letter only of the board upon which the desired connection may be finished. The operator to whose board he is trunked then receives from him the number on that board with which he desires connec-

November 22.

614,677.—T. C. WALES, JR., & F. L. RHODES. SWITCHBOARD APPARATUS, SIGNAL, AND CIRCUIT.

This invention relates to trunking systems and more particularly to the interconnection of two toll lines provided with call receiving and answering devices at different terminal boards, both, however, passing first through a connecting board, where they are represented by spring jacks. According to the invention the



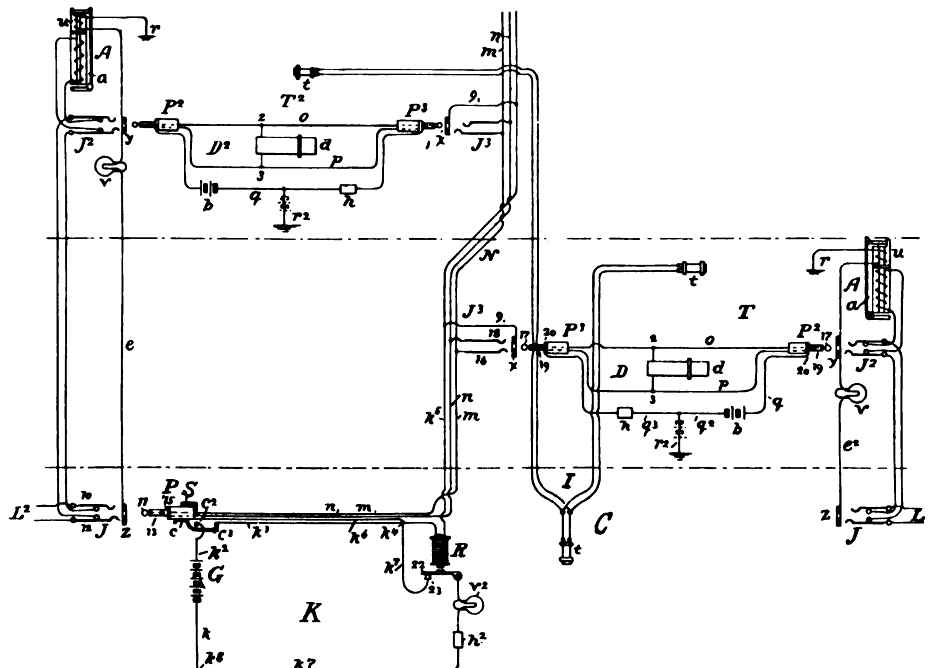
614,207. TELEPHONE EXCHANGE SYSTEM.

tion. The answering operator's telephone set has a pair of terminals in proximity to each line jack. Similarly, the calling operator's generator circuit has terminals in proximity to each jack. The mere insertion of the answering or calling plug by the proper operator serves to connect her telephone or the generator, as the case may be, without the use of special keys. The chief operator is provided with means to open the relay circuits.

answering switch sockets and call-receiving devices of a number of toll lines may be divided between two or more terminal switchboards, where incoming calls from such lines may be attended to and connections or the initial portion of connections resulting from such calls may be effected; but to provide facilities for effecting switch connections with the said toll circuits when calls come in for them over other circuits, or for much of the outgoing service generally, a connection

board is employed on which each toll line has a spring jack or switch socket through which it passes before reaching the terminal board. A local station or inter-switchboard trunk circuit extends from the connecting board, where it has a switch-plug terminal through the switchboard to the several toll boards, being provided at each with a suitable switch socket or jack, so that when it is desired to establish a connection between two toll lines ending at different terminal boards this can readily be effected by circuit in the switch socket at the connection board of the main or toll circuit which has been called for.

The usual conductor arranged to serve as a portion of a test, switchboard-signal and call-signal restoring and locking signal, is associated with each main circuit and unites the contact pieces or test rings of the said main circuit spring jacks, and ends at the terminal board in a ground or return-wire connection; a visible signal, such as a glow lamp, being included therein at the terminal-board



614,677. SWITCHBOARD APPARATUS, SIGNAL, AND CIRCUIT.

means of the said trunk. The toll or terminal boards are provided with link connections, consisting of a flexible cord conductor with a switch plug at each end, and a true connection is formed between any such pair of toll lines, first, by uniting at the terminal board of the main or toll circuit initiating the call the switch sockets of the said toll or main telephone circuit and the local trunk circuit, respectively, through the plugs and cord conductors of the said link connection; and, second, by inserting the terminal switch plug of the trunk jack. The trunk circuit has also an associate test-conductor uniting certain switch contacts or test rings of its plug sockets, and the double plug link connections at the terminal boards are in like manner similarly fitted with an associate conductor extending between the test-ring contact surfaces of the two plugs, connected with the ground or return at its center, and having a test battery between the plug and ground connection on one side of the latter and a suitable resistance on the other side.

The characteristic feature of the inven-

tion is an inter-switchboard signal and busy-test circuit, including a suitable source of current supply, which circuit we combine with the foregoing instrumentalities. One pole of the said source (which conveniently may be a battery) is grounded, or, what is the same thing, united to the return conductors of the several associate conductors, to which reference has been made. The circuit from the other pole passes by a main conductor to a plug-seat switch, and at a point beyond this divides into a plurality of branch conductors. The trunk-circuit switch-plug terminal when not in use rests in the said plug seat, which is of course placed at the connecting board, and when so resting the switch of said plug seat maintains the normally open condition of the circuit, while the removal of the said plug therefrom allows the said switch to close the circuit. One of the branch conductors of this signal circuit extends from the dividing point to a contact surface on the trunk plug adapted to register and connect with the socket contact of the main-circuit associate conductor, so that when the said plug is placed therein this branch will close the circuit by way of the said plug and socket and through the lamp signal at the terminal board and the call-signal locking magnet. A second branch conductor extends from the dividing point through a signal-controlling relay at the trunk-plug station or connecting board, and thence to the associate conductor of the trunk circuit, so that when at any of the toll or terminal boards the plug of a link conductor is inserted in a trunk switch-socket, this branch conductor has its circuit closed through the associate conductor and resistance of the link connection to the return conductor attached thereto. Of course both of these branch conductors have branch connections to the test rings or socket frames of such socket switches as their respective principal circuits may be provided with at boards other than that at which a connection is at any time made in order that the potential of the said test rings may be raised whenever the circuit to which they belong is concerned in a connection elsewhere for the purpose of enabling the customary and well-known busy-test operation to be made. A third branch of the signaling conductor is altogether localized at the connecting board, and leads from the dividing point through the circuit-controlling points of the relay of the second branch, and then through a supervisory signal (preferably a lamp), thence returning to the battery. Thus the continuity of the entire circuit depends on the position of the plug-seat switch, which holds the circuit open when the plug is in its seat, but closes it when the said plug is taken up for use. The continuity of the first branch and the presence of a current therein further depend on the united or separated relations of the trunk-plug and main-circuit switch socket at the connecting board.

To close the circuit of the second branch, it is required not only that the trunk plug at the connecting board shall be absent from the plug seat, but also that a link-connection plug shall be in a trunk switch-socket at some one of the toll terminal boards, and when this occurs the relay included therein is excited and, attracting its armature, opens the third branch circuit at its circuit-controlling points, and prevents the display of the signal.

To close the circuit of the third branch conductor, it is necessary, first, that the plug-seat switch shall be closed, and, second, that the circuit of the second branch shall be open, so that the relay armature shall be retracted.

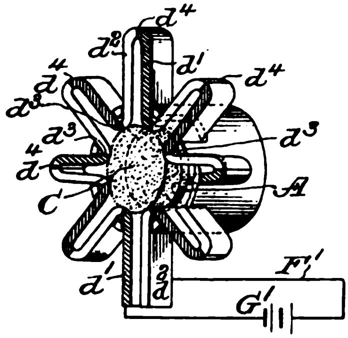
The registering signal-circuit contacts of the plug-and-socket switches and the relay points may thus be regarded as circuit-closers coöperating with the plug-seat switch for their respective branches; but since they also by reverse action open the said branch circuits they may more generally be regarded as circuit controllers.

November 29.

614,946.—W. D. GHARKY. TELEPHONIC MICROPHONE.

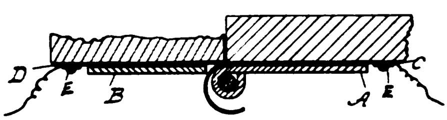
This invention has for its object the provision of means for carrying away excessive heat generated by the passage of the battery current through a microphone. This object is obtained by combining with the microphone a thermopile,

junctions of the elements of which are arranged in such relation to the microphone as to be heated thereby, and in which the effect of the current is to absorb or to convey away the heat from these heated junctions. This involves the well-known Peltier effect produced by passing an electric current through a



614,946. TELEPHONIC MICROPHONE.

thermopile, although the current directly generated by heating the contacts of the dissimilar materials in the pile is also availed of to a certain extent. The figure shows one form of the arrangement, in which the thermopile practically forms the whole or a part of the walls of the chamber in which the electrodes are



615,209. ELECTRICAL HINGE CONTACT.

placed, in which position it absorbs heat from the granular carbon. In several arrangements shown in the patent a facing of hard carbon or other material not easily oxidizable is used.

615,209.—C. BAXTER. ELECTRICAL HINGE CONTACT.

The drawing in this case is almost self-explanatory. A good contact is insured, when the hinge is included in a circuit, by means of a pair of coöperating springs C and D, one of which has a curved and elongated end which rubs against the other during the entire movement of the hinge.

"THE paper is an exceedingly creditable production, and I hasten to congratulate you on the same." FRANK B. KNIGHT.

TRADE NOTES.

"WHEN in doubt, buy Okonite," is a motto that years of experience have shown the contractor to be a safe one to follow. Anticipating a large increase in the demand for Okonite wires and cables, the Central Electric Company has put in an extra stock of style 1 and 2 wires, also of Nos. 16, 18 and 20 conductor, especially for telephone use, precluding any possibility of orders being delayed.

THE Stromberg-Carlson Telephone Manufacturing Company, Chicago, reports the successful installation of another of its intercommunicating systems in the large department store of Siegel, Cooper & Co. Fifty stations are connected, the central energy system being used. The apparatus is reported as giving the best of satisfaction, and is considered a great time-saver by the users.

LESLIE W. COLLINS, whose name is so well known in the electrical field, has recently been appointed Western representative for the Merritt Electric Company, of Middleton, Massachusetts. Mr. Collins will exploit the company's well known incandescent lamps, and take orders for renewing old ones, of which this company makes a specialty. With Mr. Collins' long and wide acquaintance among the trade, and his large amount of push, he should find little trouble in securing some handsome orders. Mr. Collins' offices will be in the Boylston building, Chicago.

THE Victor Telephone Manufacturing Company has just issued what is undoubtedly one of the neatest as well as most elaborate productions in the way of an advertising pamphlet gotten up for some time past. In an olive-green cover is contained an exquisitely printed folder giving an accurate description and correct illustration of the company's many high-grade productions, from the simple receiver to the complete and entirely perfect multiple board, built to any capacity. Not only is each subject accurately and minutely described, but the entire booklet is gotten up in such a handsome and attractive manner as to hold the undivided attention of the reader.

McDERMID MANUFACTURING COMPANY, Chicago, which for several years has made a specialty of a superior quality of telephone receivers, reports a noticeable increase in orders during the last thirty days. This shows that the exchange manager is gradually realizing the fact that it pays to furnish only the best of its kind to his subscribers.

VIADUCT MANUFACTURING COMPANY, Baltimore, with an experience of over twenty years in the manufacture of telephone apparatus of all kinds, is today undoubtedly in a better position to successfully meet the demands of telephone users than many of its competitors. Manufacturing every part of the outfit, under the supervision of time-tried experts, leaves little chance for any defect in even the smallest detail, and the expression of satisfaction from many users of Viaduct apparatus speaks well for the quality of the company's goods.

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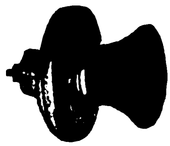

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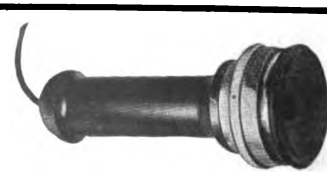

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